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# ***JPRS Report***

# **Science & Technology**

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***Central Eurasia:  
Life Sciences***

# Science & Technology

## Central Eurasia: Life Sciences

JPRS-ULS-93-001

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2 February 1993

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### Realization of 'Soil Fertility' Program

937C0037B Alma-Ata IZVESTIYA AKADEMII NAUK  
RESPUBLIKA KAZAKHSTAN in Russian No 2,  
Mar-Apr 92 pp 18-24

[Article by E. F. Gossen, Kazakhstan Academy of Agricultural Sciences; UDC 631.151.2:631/635:452. First two paragraphs are IZVESTIYA AKADEMII NAUK RESPUBLIKA KAZAKHSTAN abstract in boldface.]

[Text] For 40 years agricultural systems have been developed and implemented based on banked, non-banked, and plane-cutting processes. Extensive management of the grain branch resulted in humus loss ranging from 5 to 25 percent. In scientific research establishments on whose fields organic and mineral fertilizers were used the harvest increased by 2-3 centners per hectare.

The implementation of the scientific program "Soil Fertility" through oblast science centers will make it possible to increase the crop yield and maintain soil fertility.

The chief directions in the development of agriculture in Kazakhstan need to be formulated for the near future under conditions of the transition to market relations and multi-use agriculture.

Soil fertility is an integral index reflecting natural, historical, and socioeconomic conditions, as well as the level of development of scientific and technical progress and the general culture of society. The key positions of problems, as in the past, are oriented at a considerable increase in produce production based on the elimination of absence of personal responsibility for the land, increasing soil fertility, resistance, and productivity of agriculture with consideration of the forecasted global changes in the climate, the need for improving placement, and specialization of agricultural production and improving technologies.

During the transition to market relations the role of soil fertility as an economic and ecological factor is sharply increasing, since the results of agricultural activity of all the land users and the condition of the environment depend on soil fertility above all else.

The new economic conditions necessitate a higher level of scientific support for agriculture and the integration of science and production, and the active assimilation of the achievements of science and application in agriculture.

We know that agriculture in Kazakhstan has traveled a long and difficult path of development. Along with complex climatic conditions (acute drought, erosion processes, salinization and alkalinity of the soils, early night frosts, etc.) factors were always present that were associated with the system of authority and production relationships conducted by government policy. These were frequently accompanied by deformations in the agroindustrial complex. At the same time, the development of theoretical studies in the field of agrarian

sciences created tremendous prerequisites for the efficient use of the land and effective performance of agriculture. Ideas of a differentiated approach to the diversity of economic and agricultural forms have been repeatedly suggested by applied scientists in our country (A. G. Bolotov, V. V. Dokuchayev, A. V. Chayanov, N. I. Vavilov, D. N. Pryanishnikov, V. R. Vilyams, N. M. Tulaykov, A. G. Doyarenko, A. N. Kostyakov, T. S. Maltsev, A. I. Barayev, et al.). Systems of soil protection agriculture, which appeared in the 1960's, also formed as a protest and alternative to the paralyzing pattern and dictates.

In the last 40 years alone Kazakhstan and the adjacent steppe rayons in the southern Urals and Western Siberia have experienced four agrarian-economic periods of agricultural development: the first, post war (1946-1953), assimilation of virgin lands; the second (1954-1965), assimilation of fallow lands and plowing up of low productivity soils with radical improvement; the third (1966-1985), the development and implementation of soil protection agriculture; the fourth (1986-1990), the development of intensive technologies of raising crops.

It should be noted that prior to assimilation of virgin and fallow lands in the 1930's and 1940's in the Asian portion of the country, including Kazakhstan, grass rotation with basic processing—tilling with turning in of the peat layer—were introduced.

From current stances on protecting the soil from deflation it would be possible to consider that three fields of perennial grass in a nine-field crop rotation according to V. R. Vilyams or two output fields of grass in a nine-field crop rotation according to I. V. Yakushkin are a means of increasing soil fertility and protecting it from erosion. At the same time, erosion and deflation were displayed in the remaining fields of crop rotation in the cultured tilling of annual crops as well as after the peat layer was plowed under and soil fertility was lost.

During the period of assimilation of virgin and fallow lands, grass rotation was considered from the point of view of reducing the proportion of perennial grasses and even their complete substitution with annual crops with primary processing of the soil—tilling with plows.

During this period honored academician T. S. Maltsev, of the All-Union Academy of Agricultural Sciences imeni V. I. Lenin, in searching for measures to control drought and preserve soil structure as a factor of fertility and increasing the harvest of spring wheat in the Urals, developed a non-banked crop rotation, assuming that annual plants with the decomposition of their roots under anaerobic conditions would cease to destroy the soil structure.

Thus, the grass rotation system, which is based on processing the soil with a plow, and T. S. Maltsev's system, which is based on non-banked processing, have the same theoretical basis: the creation of a water-stable structure by means of an anaerobic process of decomposition of the root system of cultivated crops in the first

case of perennials and the latter of annuals. The soil protecting role of live plants and their post-harvest matter (stubble, as mulch) is not enhanced by either soil processing system. The grasses and stubble are embedded into the soil during tilling and deep scuffling, up to 10 cm, of the stubble. This theory also existed during the assimilation of virgin and fallow lands. During a short period, from 1954 through 1965, approximately 42 million hectares of virgin and fallow land was assimilated in the country, 25 million hectares in Kazakhstan alone. As a result, the huge area was left without a natural protective plant cover, on which branch erosion of the soil occurred in the 1960's. Territories open to the wind with large areas of plowed land, a severely continental climate, low amount (350-200 mm) of precipitation in time and space, and the recurrence of soil and drought all exacerbated the damage from wind erosion. An objective need to find new theoretical and technological solutions to protecting the soil from wind erosion processes developed. Therefore, the third period was characterized by the accelerated development and practical use of methods of soil protection agriculture. The basic (revolutionary) elements of forming a soil protection system of agriculture are the plane-cutting processing of the soil with a new type (plane-cutter) of soil processing equipment and sowing using the stubble assets of the seed drill, which accomplishes four technological operations in a single trip (cultivation, sowing of seeds and fertilizers with simultaneous compacting of the soil in the sowing rows).

The wind erosion of millions of hectares of soil was stopped, but loss of humus in the soil continued. We now know that for 30 years the fertility of rich virgin lands was exhausted in violation of the agricultural law of "return". Unfortunately, even the straw is still being removed from the fields, not to mention the return of complete doses of organic and mineral fertilizers. In a word, all three periods are characterized by extensive agriculture in Kazakhstan. As a result, soil fertility decreased and 5-25 percent of humus in the soil was lost.

The decrease in soil fertility negatively affected the rates of increasing the harvest. In the first 10 years (1966-1975) after the implementation of the plane-cutting process the increase in the harvest was 1.9 centners per hectare. In the following decade the increase dropped to 0.7, and in the past five years it has dropped to 0.6 centners per hectare.

Finally, the fourth period began in 1985 with the implementation of intensive soil protection technologies, when mineral fertilizers began to be apportioned under the sowing of grain crops in scientifically sound doses. But the sowing area was only 5-6 million hectares instead of 15-20; therefore, the harvest and the gross gathering of grain in Kazakhstan did not increase. At the same time, in scientific establishments of the republic, the increase in the harvest with intensification continued, which suggests the resources of intensive technologies and the soil protection system of agriculture as a whole are not being used.

In connection with this situation, the Kazakhstan State Agroindustrial Committee and agrarians in 1989 developed a comprehensive program for increasing soil fertility in Kazakhstan through the year 2005. In addition to the organization and economic measures, its tasks include supporting the deficit-free balance of organic substance in the soil by increasing the volumes of organic matter added, expanding the sowing of perennial grasses and sidereal crops, the maximum use of straw and post-harvesting matter, and improving methods of preparing organic fertilizers and their use in the soil; reclamation work with chemical reclamation agents (phosphogypsum) on alkaline patches in the plowed field in the complex agrochemical field cultivation system (CACFC) during their fallow treatment; improvement of the use of mineral fertilizers and pesticides for removal of nutrients and very low volume spraying of herbicides with consideration of environmental protection; the use of land laws and the establishment of an order in which any use of the land occurs only on the basis of planned developments with consideration of materials for land cadastral survey.

In all, the complex program for increasing soil fertility contains 77 tables which present the volumes, needs, and requirements for all indexes and measures associated with increasing soil fertility in the oblasts of Kazakhstan. It should be noted that the program was considered and approved at a conference of Gosagroprom and the eastern department of the All-Union Academy of Agricultural Sciences imeni V. I. Lenin, and sent to all oblast agroindustrial committees.

However, it should be frankly stated that most of the outlined measures have remained on paper. The chief reason is that the entire program was developing using the administrative-command principle "from top to bottom": oblast, rayon, farm.

Specialists and scientists in the agrarian sector conducted an enormous study, calculated the needs for machines and equipment and organic and mineral fertilizers, and presented volumes of planned reclamation work. In connection with the radical changes in the political, economic, and social conditions and land reform in the villages and in spite of the command principle all the work should take place "from bottom to top": beginning in the field (section) - crop rotation - peasant farm - cooperative - kolkhoz - sovkhoz - rayon - oblast.

At present in accordance with the demands of multi-use farming and the diversity of natural conditions, it is necessary to develop complex systems (models) for agriculture in peasant (farmer) farms, cooperatives, kolkhozs, sovkhozs, agricultural companies, works and other farms on an agroterrain standard technical basis, to "work" effectively under conditions of a market economy and competition. It is necessary to increase the role of oblast scientific centers. For purposes of the further development of fundamental and applied

research aimed at intensification of agricultural production and improving the on-site scientific support of the agroindustrial complex, the Kazakhstan Academy of Agricultural Sciences was organized. The All-Union Scientific Research Institute of Grain Farming imeni A. I. Barayev, the Kazakhstan Scientific Research Institute of Water Management, and the Kazakhstan Scientific Research Institute of Karakul Sheep Breeding are under its leadership. A resolution has been adopted to transfer ten more union and republic scientific research organizations to its management.

With the creation of the Kazakhstan Academy of Agricultural Sciences, the functions of scientific research establishments have significantly expanded. Seven branch departments have been created in the Academy's system. Their chief tasks are to intensify research on the socioeconomic problems of the village and to develop a multi-use form of farming; develop the scientific foundations for efficient, ecologically sound natural use, increase soil fertility, and manage agriculture in rayons with a polluted environment; create based on modern advances in biological science new highly productive agricultural crops, varieties, hybrids, and crosses of cattle, pigs, and fowl, resource-economizing technologies, agricultural production and stock breeding; create a system of machines for the complex mechanization and automation of agriculture, water, forest, and fish management, as well as processing industries and the effective use of unconventional sources of energy; develop radically new technologies for conversion and storage of produce.

The creation of branch departments within the Academy will make possible the scientific-methodical support and coordination of research in scientific establishments working on the problems of developing an agroindustrial complex in Kazakhstan.

There is no doubt that the problems of soil fertility need the efforts of not only the biological science departments of our academies, but also all of the agrarian, land management, and agrochemical services of the agroindustrial complex. The expanded restoration of soil resources and protection are the key to the development of agriculture. The expanded restoration of soil fertility currently entails:

1. Extensive use of organic fertilizers, the use of green manuring, grass sowing, compacting, post-harvest sowing, plant matter, microbiological preparations, hydrogels, and other soil fertility stimulants. The technologies should provide for the strictly regulated and ecologically safe use of mineral fertilizers, pesticides, gypsum, and other soil improving materials.

2. The development of adaptive horticulture systems that support the maximum compatibility of crops with specific soil and ecological conditions, the creation of varieties of genetically programmed traits with high photosynthesizing ability, a powerful root system for

effective plant nourishment, the production of a maximum high quality harvest, and the maintenance of a large amount of organic substances in the soil.

3. Harvest programming and management of the production process based on discovery of extensive bonds in the system "Sun (FAR [as published]) - plant - soil" and development of fertility models and the production of very resistant harvests.

4. The development of a system of a scientific organization of agroterains (agricultural topography) that provide for the optimum ratio of various species of crops and the complete coverage with plants of all the elements of the land and also protection of the soil covering.

5. Determination of soil-ecological sections homogenous from a farming point of view for their soil properties and a set of other ecological conditions (relief, technological properties) and suitable in their dimensions for independent use.

The methods and technologies for the expanded restoration of soil fertility should include standard approaches and current information support in the form of automated information searching systems, especially an integrated system of operative diagnostics (ISOD) of the extent of provision for the soil and plants with nutrients according to the criteria of balance and a number of other systems. But in this case it is first important to neutralize the adverse effects on the soil, and then carry out complex measures and optimize the intrasoil processes and facilitate a steady increase in soil fertility and high plant productivity.

The role of agrarian science is increasing under conditions of the transition to a market economy and the developing economic and ecological problems.

In the near future it is necessary to focus the attention of all scientific establishments on:

- the development and increase in the level of fundamental and complex applied research, especially designer and design-technology developments, including international programs in the field of physical geography and land use, soil science, maintaining and increasing soil fertility, alternative and organic systems of agriculture, land and water cadastral survey, ecology, and economics;
- the development of a theory of methods, imitation models, and instrument systems for organizing agro-ecological monitoring and an economic mechanism of soil fertility management under conditions of market relations;
- the development of unified methodological bases for the preparation of projects for the complex reclamation and in general the management of any farm on a land section with consideration of the land cadastral survey and ecological classification of lands;



- the creation of radically new systems of machines for the complex mechanization of an entire cycle of studies that meet the needs of microzonal agriculture systems, ecological safety, resource-economization, multiple usage of farms and comfort of human labor conditions;
- the integration of science with production by means of the maximum approximation and accessibility of scientific developments for production, especially for newly created peasant farms and other types of farms.

At present the land management service allocates only land sections, but the peasant farms need to present a microzonal complex plan of scientifically sound use of the lands. Demonstration drafts (models) are needed for advertising and implementation throughout agricultural microzones in Kazakhstan, as well with a fully technological base and cost together with the residences and other structures. There should be a choice of plans.

In order to increase the interest and receptiveness of farms to scientific advances, it is necessary to carry out measures for economic incentive for the technical and technological rejuvenation of production by allocation of purposeful subsidies from the budget, privileged taxation of profit, and the creation of innovation funds for supporting innovation.

All of this necessitates the creation of automated and information searching systems with a data bank on the quality status of the land, properties and soil fertility, relief, as well as large scale areas with horizontals, and crops being raised that are part of the microzonal agricultural land section in any farm.

Finally, the agrarian scientists need to advertise not only their own developments, but also the means of using laws on the land, privatization, and priority development of the aul, the village, and the entire agroindustrial complex.

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### **Kazakhstan Scientists on Soil Fertility**

937C0037C Alma-Ata IZVESTIYA AKADEMII NAUK RESPUBLIKA KAZAKHSTAN in Russian No 2, Mar-Apr 92 pp 91-92

[Article by N. N. Voronina]

[Text] The Joint Session of the General Meeting of the Department of Biological Sciences, Kazakhstan Academy of Sciences (KAS) and the Department of Agriculture, Reclamation, and Forestry, Kazakhstan Academy of Agricultural Sciences (KAAS) was held November 26, 1991. It was devoted to one of the most urgent problems of our time: the problem of soil fertility.

Participating in the work of the session were KAS president and KAS academician U. M. Sultangazin; AS vice-president and KAS academician I. O. Baytulin;

KAAS vice-president, KAAS corresponding member, and KAS academician E. F. Gossen; KAS chief science secretary and KAS corresponding member K. A. Sagadiyev; and scientists—soil scientists, botanists, zoologists, microbiologists, physiologists, farmers, land reclamation specialists, specialists in the fields of plant protection, genetics, and crop selection, and soil erosion, as well as representatives of government and public establishments, and higher educational institute teachers from Alma-Ata.

The session of the General Meeting of the two academies was opened by academician-secretary of the KAS Department of Biological Sciences, KAS corresponding member K. T. Tashenov, who emphasized that only a scientific approach to the problem of soil fertility and a scientific rationale for the optimal use of the fertile horizon of the soil will make it possible for Kazakhstan agriculture to emerge from its crisis.

Director of the Order of the Worker's Red Banner of the Institute of Soil Science, KAS corresponding member Zh. U. Akhanov presented a report on the "Status and Theoretical Foundations for the Restoration of Soil Fertility"; KAAS vice-president and corresponding member E. F. Gossen reported on scientific support for the "Soil Fertility" program; KAS Microbiology and Virology Institute director and KAS academician A. N. Ilyaletdinov reported on the theme: "The Role of Microorganisms in the Dynamics of Soil Fertility"; and KAS academician Ye. V. Gvozdev reported on "Invertebrate Animals and Soil Fertility". KAAS academician M. K. Suleymenov reported on the ways of increasing soil fertility in northern Kazakhstan, and the director of the Issues to be addressed by soil zoologists in Kazakhstan include: 1. more extensive study of soil invertebrates and the effect of humans on them and determination of the natural factors and agrotechnical methods governing the structure of the animal population in the soil; 2. the study of individual groups of invertebrates in the decomposition of plant materials and cycling of mineral and organic particles in the soil; 3. the development of methods of biological soil reclamation; and 4. the study the effects of chemical substances and industrial wastes on soil invertebrates. References 15: 10 Russian, 5 Western.

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### **Increasing Soil Fertility on Irrigated and Non-Irrigated Land in Kazakhstan**

937C0038B Alma-Ata IZVESTIYA AKADEMII NAUK RESPUBLIKA KAZAKHSTAN in Russian No 2, Mar-Apr 92 pp 30-35

[Article by I. Abugaliyev, Kazakhstan Agriculture Scientific Research Institute imeni V. R. Vilyams; UDC 45:631.67:631.582(574)]

[Abstract] The 47 million hectares of land being farmed should be enough to meet Kazakhstan's needs, but the

fields are affected by pests and disease. Recommendations by scientific establishments in Kazakhstan based on many years of research have been implemented, but the culture of agriculture remains low. Both biological and physical factors are contributing to soil loss. There has also been a sharp decrease in soil fertility on farms where efficient crop rotation is not practiced and organic and mineral fertilizers are over- or underused. Between 1988 and 1990 there has been a 32.9 percent decrease in the amount of fertilizer used and half of the plowed fields and one-third of the irrigated fields lack adequate amounts of free phosphorus, without which soil fertility and the harvest cannot be increased. Problems that need to be addressed include the following: 1. Arable land needs to be ecologically and economically evaluated and the needs of each section for reclamation and efficient use need to be determined; 2. Technology needs to be developed for preserving and increasing soil fertility with respect to zonal ecological and economic conditions; 3. Technologies should envisage the maximum application of methods of "biologization" of agriculture and provide for the ecologically safe use of mineral fertilizers and pesticides; 4. Optimum parameters (fertility models) need to be developed for the basic types of arable soils in Kazakhstan with respect to basic zonal structures; 5. A system of adaptive horticulture needs to be developed for the maximum compatibility of crops with soil and ecological conditions.

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**Effect of Anthropogenic Factors on Microorganisms of Phosphorus Cycle in Lake Balkhash**

937C0038C Alma-Ata IZVESTIYA AKADEMII NAUK  
RESPUBLIKA KAZAKHSTAN in Russian No 2,  
Mar-Apr 92 pp 54-60

[Article by K. Sh. Bakirova, Microbiology and Virology Institute, Kazakhstan Academy of Sciences; UDC 579.68+579.26]

[Abstract] Forty water samples and twenty soil samples were collected from Lake Balkhash in an investigation of three zones most heavily subjected to anthropogenic stress: Bertys Bay, Tarangalyk Bay, and Malyy Sary-Shagan Bay, which are polluted with waste from the Balkhash Mining and Smelting Plant that contains heavy

metal ion concentrations exceeding the maximum acceptable quantity by several-fold. The results showed that the numbers of microorganisms in the phosphorus cycle (phosphorus-mobilizing and phosphate-dissolving) increase with distance from the site of sewage dumping. It was also found that the greater the dilution of the discharges, the better the microorganisms of both groups developed. A persistent negative effect of heavy metal ions on the population and phosphatase activity of microorganisms of the phosphorus cycle was demonstrated in natural as well as experimental conditions. In conclusion, the heavy metal ions affect the ability of microorganisms of the phosphorus cycle to mobilize phosphates, which ultimately upsets the natural biotic cycle of the element. Figures 4; tables 2; references 8; 7 Russian, 1 Western.

**Increasing Erosion Resistance of Irrigated Soils**

937C0038D Alma-Ata IZVESTIYA AKADEMII NAUK  
RESPUBLIKA KAZAKHSTAN in Russian No 2,  
Mar-Apr 92 pp 60-64

[Article by E. K. Mirzakeyev and N. I. Yakovleva, Soil Science Institute, Kazakhstan Academy of Sciences; UDC 631.459.23(574.53)]

[Abstract] Irrigation erosion was studied on gray-brown irrigated soils of Chimkent Oblast. The data indicate a decrease in the humus and nitrogen content in the heavily eroded section and an increase in the lower alluviated section of the slope. Three zones—erosion, stabilization, and accumulative—form on irrigated areas in connection with the hydrologic cycle. This study demonstrated that spraying the soil with solutions of the polymers K-4 and PGK-AA along the bottom of the flood furrows before flooding without subsequent disturbance of the soil makes the soil more water-stable and resistant to erosion. It was shown that K-4 and PGK-AA create on the bottom of the furrows a rough, structurized layer of soil that reduces the speed of the flood stream from 0.33 m/sec to 0.2 m/sec. This treatment is an important means of controlling irrigation erosion on irrigated gray-brown soils. It also improves the water cycle of the soils, decreases nutrient loss, and creates more favorable crop growth and development conditions. Tables 2; references 3; Russian

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**Identification of DNA-Binding Proteins of Extracellular Vaccinia Virions**

937C0080B Moscow DOKLADY AKADEMII NAUK  
in Russian Vol 323 No 4, Apr 92 (manuscript received  
28 Jan 92) pp 789-793

[Article by G.G. Prikhodko, A.N. Chkheidze, I.Kh. Urmanov, V.L. Karpov, S.I. Petrunina, S.K. Vasilenko and A.D. Mirzabekov, academician, All-Union Scientific Research Institute of Molecular Biology, Koltsovo, Novosibirsk Oblast; Institute of Molecular Biology imeni V.A. Engelgardt, Russian Academy of Sciences, Moscow; UDC 577.113.5]

[Abstract] Hybridization of cloned segments of the vaccinia virus genome with "protein shadow" DNA was used for identification of DNA-binding proteins of extracellular vaccinia virions [Mirzabekov, A., et al., Methods in Enzymol., 170:386, 1989]. The study was conducted with vaccinia virus strain LIVP grown in BHK-21 cells. The resultant findings led to the identification of four groups of DNA-binding proteins: 11 kD, 33 kD, 60 kD and 70 kD. In addition, preliminary data are presented on open translation frames for these proteins as an initial stage in the identification of genes encoding DNA-binding proteins in vaccinia virus. Figures 2; tables 1; references 11: 1 Russian, 10 Western.

**Taurine Effects on Ultrastructure of Parallel Fiber-Purkinje Cell Synapses in Frog Cerebellum**

937C0080A Moscow DOKLADY AKADEMII NAUK  
in Russian Vol 323 No 4, Apr 92 (manuscript received  
07 Feb 92) pp 786-789

[Article by N. V. Samosudova, N.P. Larionova and L.M. Chaylakhyan, corresp. member, Russian Acad. Sci., Institute of Information Transmission Problems, Russian Academy of Sciences, Moscow ; UDC 577.3]

[Abstract] Synaptic plasticity vis-a-vis taurine—an inhibitory neurotransmitter—was investigated in vitro on

*Rana temporaria* cerebellum. The ultrastructural findings were that incubation of the cerebellum in Ringer's solution with 10 mM taurine resulted in an increase in the percentage of parallel fiber-Purkinje cell synapses showing bouton encapsulation by post-synaptic projection to 24.0 percent from 3.0 percent in control preparations. Electrical stimulation of the parallel fibers with bipolar electrodes (0.1 Hz, 10E-4 to 10F-5 A) in conjunction with taurine increased the percentage to 42.0 percent. These and other observations were accepted as ultrastructural evidence of synaptic adaption to elevated levels of an inhibitory neurotransmitter. Figures 1; tables 1; references 7; 2 Russian, 5 Western.

### **Cloning and Expression of Human Proinsulin Gene in *Bacillus Amyloliquefaciens* Selected for Low Exoprotease Activity**

927C0509A Moscow BIOTEKHNOLOGIYA in Russian No 1, Jan-Feb 92 (manuscript received 02 Jul 91) pp 9-13

[Article by G.N. Selivanova, T.G. Plotnikova, Yu.V. Iomantas, V.A. Naroditskaya, and Yu.I. Kozlov, All-Union Scientific Research Institute of Genetics and Breeding of Industrial Microorganisms, Moscow; UDC 615.357.37.07]

[Abstract] UV irradiation was employed on *Bacillus amyloliquefaciens* A50 for the selection of mutants with low levels of exoproteases for production of human proinsulin (HP). Two such strains, *B. amyloliquefaciens* GT32 and GT74, were selected and, along *B. amyloliquefaciens* A50, were transformed with recombinant plasmid pBA130 bearing the HP gene. In all 3 strains the HP gene was under the control of [g]-amylase regulatory elements. Under optimum conditions production of HP reached 6 mg/L with *B. amyloliquefaciens* GT32 (pBA130). Secretory efficiency in *B. amyloliquefaciens* GT32 was on the order of 97 percent. *B. amyloliquefaciens* GT74 (pBA130) was less efficient due to low  $\alpha$ -amylase activity and growth rate, yielding only 0.1 mg/L of insulin, while immunoassays failed to detect HP production by *B. amyloliquefaciens* A50. Figures 6; tables 1; references 22: 7 Russian, 15 Western.

### **Potato Cell Clones Resistant to Pectolytic Enzymes and Phytophthora-Resistant Regenerants**

927C0509B Moscow BIOTEKHNOLOGIYA in Russian No 1, Jan-Feb 92 (manuscript received 20 Jun 91) pp 18-22

[Article by V.A. Avetisov, Yu.V. Davydova, O.S. Melik-Sarkisov, and M.A. Protsenko\*, All-Union Scientific Research Institute of Agricultural Biotechnology, All-Union Agricultural Academy, Moscow; \*Institute of Biochemistry imeni A.N. Bakh, USSR Acad. Sci., Moscow; UDC 581.143.6]

[Abstract] Studies were performed on the correlation between susceptibility of potato leaves (*Solanum tuberosum*) to damage by pectolytic enzymes, capacity of explants to form calluses, and resistance of regenerants to *Phytophthora infestans*. The results with several potato cultivars demonstrated a direct correlation between insusceptibility of the leafy tissue to enzymatic damage on the one hand, and callus formation and resistance of regenerated plants to fungal injury on the other. Technical details are presented on the experimental approach used for callus generation, coupled with the observation that one manifestation of resistance included delayed sporogenesis by the pathogen. Figures 1; tables 4; references 13: 6 Russian, 7 Western.

### **Mobilization of RSF1010-Derived Chimeric Plasmid From *Escherichia Coli* to *Bacillus Subtilis* by pRP4**

927C0509C Moscow BIOTEKHNOLOGIYA in Russian No 1, Jan-Feb 92 (manuscript received 09 Jul 91) pp 23-25

[Article by V.G. Doroshenko and V.A. Livshits, All-Union Scientific Institute of Genetics and Breeding of Industrial Microorganisms, Moscow; UDC 663.18[579.252.5.08]

[Abstract] Details are provided on the construction of a bireplicon plasmid pERSF from plasmid pAYC32 (derived from non-transmissible plasmid pRSF1010 bearing ori-T and mob genes) and the temperature-sensitive plasmid pTV1 (derived from pE914). The purpose was to test the feasibility of mobilizing transmission of pRSF1010 from a gram-negative host to a gram-positive recipient. The results demonstrated that plasmid RP4 (incompatibility group IncP) mobilized pERSF transmission from *E. coli* to *E. coli* with a frequency of  $3 \times 10^{-10}$ , and to *Bacillus subtilis* with a frequency of  $1.6 \times 10^{-6}$ . Persistence of pERSF in *B. subtilis* was temperature-dependent. Attempts at mobilization to *Streptococcus lactis* and *S. faecalis* were unsuccessful. In general, problems with transmission of pERSF were attributed to its instability in *E. coli*. Figures 1; tables 2; references 16: 6 Russian, 10 Western.

### **Serratia Marcescens Endonuclease: New Enzyme Source**

927C0509D Moscow BIOTEKHNOLOGIYA in Russian No 1, Jan-Feb 92 (manuscript received 09 Jul 91) pp 26-29

[Article by D.V. Yusupova, O.V. Porfiryeva, R.B. Sokolova, and Ye.V. Petukhova, Kazan State University; UDC 663.152]

[Abstract] *Serratia marcescens* ATCC 9986 was employed in induced mutation studies for selection of superproducers of exoenucleases. Two promising strains—designated S. marcescens 28 and 28-13—with endonuclease activities in the culture fluid of 60,000-99,000 U ml<sup>-1</sup> (vs. 690 U ml<sup>-1</sup> for 9986) were identified. Physiologically, the superproducers differed from the parental strain in slower growth rates, larger cell size, greater susceptibility to penicillins and nalidix acid, higher protein concentration/cell and elevated chitinase activities. Figures 2; tables 2; references 17: 12 Russian, 5 Western.

### **Preparation of Gelatin-Dextran Conjugates**

927C0509E Moscow BIOTEKHNOLOGIYA in Russian No 1, Jan-Feb 92 (manuscript received 06 May 91) pp 56-59

[Article by I.V. Glushnev, N.S. Golubev, V.A. Gindin, G.P. Ivanova, T.M. Taratina and B.V. Moskvichev,

All-Union Scientific Research Technological Institute of Medical Antibiotics and Enzymes; UDC 615.373.012:665.931.7]

[Abstract] Gelatin-dextran conjugates were prepared as potential plasma substitutes and analyzed vis-a-vis commercial products. Synthesis included tryptic hydrolysis of gelatin followed by reaction with potassium periodate oxidized dextran (60 kD; Poliglyukin [as published]). The resultant products covered a large range of molecular sizes (10-100 kD), had a pH of 7.2-7.3 and a relative viscosity of 0.08-0.09 dL/g for 3.2 percent solutions. These characteristics were comparable with the commercial plasma substitutes Chemacel (Behringwerke, FRG) and Zhelatinol (Plant of Medicinal Preparations, Leningrad). In addition to their potential as plasma expanders, the conjugates were also shown to behave as detoxicants. Testing on rats against bacterial toxins demonstrated that the gelatin-dextran (48 percent oxidized) conjugate enhanced the survival of rats exposed to *E. coli* toxin from 0 to 37 percent. In the case of *Pseudomonas aeruginosa* toxin the increase was from 17 to 30 percent. In both cases the results exceeded those obtained with Chemocel and Zhelatinol. Figures 3; tables 2; references 6: 4 Russian, 2 Western.

#### Composite Support Films for Cell Cultures

927C0509F Moscow BIOTEKHNOLOGIYA in Russian No 1, Jan-Feb 92 (manuscript received 15 Sep 91) pp 60-62

[Article by Yu.I. Alekseyeva, Ye.F. Bukanova, T.S. Solovyeva, I.A. Tutorskiy and V.M. Fomchenkov, Moscow Institute of Fine Chemical Technology imeni V.M. Lomonosov; UDC 57.086.83]

[Abstract] Composite support films for cell culture were formulated by combining vinylidene fluoride-hexafluoropropylene (SKF-26) copolymer with polysaccharides. Assessment of the physicochemical characteristics of the composite films in conjunction with biocompatibility and growth of BHK-21 cells led to the determination that films containing 0.5 percent carrageenan constituted the optimum support system. Almost as acceptable were films containing 0.25 percent sodium alginate, while films prepared with zosterin were somewhat less desirable as a cell support matrix. Such flexible support films offered considerable advantages in cell viability and recovery in comparison with growth on rigid supports. Figures 2; tables 2; references 5: 3 Russian, 2 Western.

#### Biotechnical Purification and Odor Removal From Gaseous Wastes

927C0509G Moscow BIOTEKHNOLOGIYA in Russian No 1, Jan-Feb 92 (manuscript received 17 Jun 91) pp 63-66

[Article by A.V. Lukanin, A.T. Aysakov and G.Yu. Ostayeva, All-Union Scientific Research Institute of Protein Synthesis, Moscow; UDC 66.074.2]

[Abstract] cursory description and rationale is provided for the use of a bioscrubber for purification of gaseous wastes, based on a mass-exchange swirl-chamber design utilizing a biofilter. Testing at a particle board plant demonstrated the scrubbers to be effective in removing 95-99 percent of formaldehyde when used in combination with formaldehyde-adapted activated sludge. The latter was selected for use in the process after a month of aeration with air containing 300 mg/m<sup>3</sup> of formaldehyde per 2-2.5 g/L of sludge. Figures 3; tables 2; references 7: 3 Russian, 4 Western.

#### Preclinical Trials With Recombinant Human Interferon- $\alpha$ - and - $\gamma$

927C0509H Moscow BIOTEKHNOLOGIYA in Russian No 1, Jan-Feb 92 (manuscript received 29 May 91) pp 67-70

[Article by Yu.T. Kalinin, V.I. Marchenko, L.A. Denisov and Ye.L. Morozova, Institute of Immunology, Lyubuchany, Moscow Oblast; UDC 615.373.076/-078]

[Abstract] Recombinant human interferon- $\alpha$ - (IFN-A) and - $\gamma$  (IFN-G) underwent pharmacodynamic assessment on a variety of tissue cultures, outbred and inbred mice lines and Wistar rats, as part of a preclinical trial program. The results demonstrated that antiviral (influenza A/PK/8/34) activities of IFN-A and IFN-G were most effective in human cell lines, with IFN-G active only in the human cell lines. Similar observations pertained to mouse studies. In addition, while IFN-A exhibited some modulation of various aspects of the humoral and cellular immune responses in mice, IFN-G did not. Acute and long-term toxicity studies on rats showed both preparations to be nontoxic in doses significantly exceeding—10E+5-fold—human therapeutic levels. However, studies with human tissue cultures yielded cytotoxic manifestations in doses of 10E+4-10E+5 IU/ml, on par with toxic side effects reported in clinical trials with 68-198 x 10E+6 IU on single intramuscular administration. The general impression was that preclinical pharmacodynamic evaluations of IFN preparations are best conducted in vitro on human cell lines. Tables 2; references 13: 5 Russian, 8 Western.

#### Light Transmission of Suspensions and Growth of Photoautotrophic Organisms

927C0509I Moscow BIOTEKHNOLOGIYA in Russian No 1, Jan-Feb 92 (manuscript received 22 Feb 91) pp 78-79

[Article by I.A. Zolotukhin, Perm State Pedagogical Institute; UDC 628.163]

[Abstract] A key factor underlying in vitro cultivation of photoautotrophs is the level of light transmission in the suspension, which may be considerably improved by the use of light guides for biomass support (eg., powdered coal, glass, polymers, etc). The essential equation for determining the level of light transmission derived for

coal dust-based suspensions was shown to be the following:  $F = F_0 \exp^{(0.00115 + 3.51 \times 10^{-4} C)x}$ , where  $F$  represents light intensity at a given point in the suspension,  $F_0$  is the initial surface intensity,  $C$  is the concentration ( $\text{mg}/\text{dm}^3$ ), and  $x$  is the distance from the surface to a given locus in the suspension. Figures 1; references 10: 6 Russian, 4 Western.

**Methanol- and Ethanol-Sensitive Cellular Microbiosensors Utilizing pH-Sensitive Field Effect Transistors**

937C0046A Kiev UKRAINSKIY BIOKHMICHESKIY ZHURNAL in Russian Vol 64 No 3, May-Jun 92 (manuscript received 20 Jul 91) pp 96-100

[Article by Ya.I. Korpan, M.V. Gonchar, A.P. Soldatkin, N.F. Starodub, A.K. Sandroviskiy, A.A. Sibirnyy and A.V. Yelskaya, Institutes of Molecular Biology and

Genetics, Kiev, and of Biochemistry imeni A.V. Palladin, Lvov Branch, Ukrainian Academy of Sciences; Kiev State University imeni T.G. Shevchenko; UDC 577.150.87+543.8:547.262]

[Abstract] Specific ethanol- and methanol-sensitive biosensors were constructed with the use of fungal proton-extruding mutants immobilized via calcium alginate on pH-sensitive field transistors. The system relied on *Hansenula polymorpha* (blocked at formate dehydrogenase) for methanol detection and *Pichia pinus* (blocked at acetyl-S-CoA synthetase) for ethanol. The sensitivity of both biosensors at room temperature was on the order of 0.5 mM alcohol with a linear response over 5-100 mM and  $\pm$  5-10 percent deviation. The lag time to a potentiometric plateau was 20-25 min with a 25 mM alcohol sample and a biomembrane prepared with 10 mg/ml cell concentration. Initial data indicate that a more rapid response time is possible with higher cell concentrations. Figures 5; references 23: 1 Ukrainian, 4 Russian, 18 Western.

**Status and Theoretical Foundations for  
Restoration of Soil Fertility in Kazakhstan**

937C0037A Alma-Ata IZVESTIYA AKADEMII NAUK  
RESPUBLIKA KAZAKHSTAN in Russian No 2.  
Mar-Apr 92 pp 3-11

[Article by Zh. U. Akhanov, Soil Science Institute,  
Kazakhstan Academy of Sciences; UDC 631.452]

[Text] The current status of soil resources in Kazakhstan and problems of their efficient use with respect to the agroecological potential and the theoretical aspects of the restoration of soil fertility based on the optimization of soil properties, cycles, and processes are considered.

The stability of human civilization and perspectives of growth in public welfare in many ways are determined by soil fertility, the chief national wealth of any country, and by the relationship of society to it. This relationship should be aimed at the protection and efficient use of the soils and at restoration of fertility based on a strictly classical definition: as the best set of soil properties to support the harvest of crops.

Such a definition of soil fertility prompted development in various directions: agriculture, agrochemistry, agroengineering, horticulture, reclamation, etc., which in turn resulted in the neglect of the soil itself as a natural-historical entity, as the basic resource of agricultural production. Each direction attempted to solve the problems of soil fertility independently without considering the properties and processes in the soil. In addition, it was not considered that agricultural intensification could have a rational basis if a comprehensive program of increasing the effective and potential soil fertility were included.

The current status of the soil in Kazakhstan necessitates the development of a new concept, the main point of which is to jointly improve the soil and increase its fertility and productivity. The problem of increasing soil productivity can be solved by improving zonal systems of agriculture based on the evaluation of the agroecological potential in the regional and intrafarm aspects, and the introduction of technologies of restoration of soil fertility on scientifically grounded principles of improving soil properties, cycles, and soil processes as a whole. In this connection arises the natural question: Does agricultural development in Kazakhstan fit this classical definition of soil fertility? Are numerous campaigns to bring the country's agriculture out of its crisis, which have not had the desired results, the answer to this?

We know that in past decades various measures have been taken to solve the problem more quickly. However, they did not take into account improving the object of agricultural production, the soil. Large scale measures for the adoption of chemical methods and water reclamation primarily set their goal due to the forced development of irrigation, mechanization, and the deliveries

of mineral fertilizers to compensate for the progressive deterioration of soil resources.

Agricultural intensification with an emphasis on the adoption of chemical methods, which has been accepted as the leading edge in foreign countries and strictly practiced, has not only expanded the opportunity for targeted improvement in the productivity of agroecosystems, but has also sharply increased the anthropogenic load on the soil, which consists of pollution with heavy metals, nitrates, and fluoride in the soil and horticultural products. The excess content of nitrogen and phosphorus in the soil is the factor limiting fertility, due almost exclusively to the adoption of chemical methods of intensification, especially in the flood plain.

As a whole, failures in bringing the country's agriculture out of crisis in many ways have been predetermined by underestimating the need to create the optimal soil parameters for fertility and forecasting their possible transformation.

An analysis of the soil in Kazakhstan and the effectiveness and productivity of soils in plowed fields makes it possible to conclude that agricultural production can be increased in three ways:

1. By increasing the area of agricultural land and plowed fields. Kazakhstan has tremendous land resources with a total area of 272 million hectares. Mountains comprise nine percent of the total area of Kazakhstan. Desert brown, grey-brown, and takyrs soils, solonchaks soils, and sands cover 47 percent of the land. The total area of plowed lands is 35 million hectares.

The current condition of the plowed lands and soil resources indicates that by using an extensive means of agricultural development, we have not only exhausted the resources of fertile soils while developing them, but we have also considerably "touched" the low-productivity soils. Water resources are the limiting factor for the development of extensive agriculture in irrigation zones.

2. Optimizing the use of plowed fields with consideration of the agroecological potential. The administrative arrangement of plowed fields and crops without serious consideration of the genetic aspects of the soil, plants, and other natural conditions is currently a clear inhibitor to the effective use of land resources.

The presence of enormous areas of highly fertile soil resources in the steppe zone of Kazakhstan was the basis for their large scale use for the development of non-irrigation agriculture and the raising of valuable varieties of spring wheat. In particular, in the subzone of the moderately humid steppe with highly fertile ordinary chernozems, where the area of the plowed fields is 7.16 million hectares, the raising of grains without irrigation here is more favorable. The southern chernozems, in a subzone with a moderately dry steppe with an area of 7.3



million hectares, are not sufficiently stable for non-irrigation agriculture for raising spring wheat. Here the number of drought years is 30 percent.

The largest area (10.1 million hectares) of plowed fields is concentrated in the subzone of the dry steppe with dark chestnut soils. Due to their agroclimatic conditions, these soils are in the category of poor resistance for non-irrigation agriculture for raising wheat. The number of drought years is 40 percent.

In the plowed fields of northern Kazakhstan there are 5 million hectares of chestnut and light chestnut soils in the dry and very dry steppes that are not productive in non-irrigation agriculture for raising grain. The number of drought years is 50 percent in the chestnut and 75 percent in the light chestnut subzones.

Analysis of the average multi-year wheat harvest for 1975-1985 demonstrated the complete dependence of conditions of soil formation on the coverage of precipitation and in the subzone of ordinary chernozems was 13 centners/hectare; southern chernozems—10.7 centners/hectare; in the dark chestnuts—8.5; in the chestnuts—5.7; and in the light chestnuts—3.5 centners/hectare. If we take into account that for northern Kazakhstan an economically sound wheat harvest is no less than 7.5 centners/hectare and there is a shortage of natural moisture in the chestnut and light chestnut soils, the raising of grain makes farming on areas of more than four million hectares unprofitable.

During the period of the 35 year use of virgin lands, Kazakhstan produced more than 700 million tons of "inexpensive" bread, since they were able to do so with minimum costs in labor, energy, and materials. However, this production developed with maximum ecological costs which resulted in profound changes and damage to the environment. We can confidently state that not one other republic has so intensively used its ecological resources in agricultural production as has Kazakhstan.

These harvest indexes show that essentially new approaches to the agricultural system and new technologies for restoring soil fertility and raising crops are needed.

Another poor ecological situation is developing in southern Kazakhstan where irrigation agriculture has been developed on an area of 2.5 million hectares concentrated in the valleys of the Syrdarya, Chu, Ili, Talas, and Karatal Rivers, etc. Whereas on the non-irrigated areas the advent of the critical ecological situation is associated with the use of a great deal of humus on the formation of the harvest, in the irrigated areas the critical situation has developed with even greater use of water to irrigate different crops. Thus, the actual amount of water used to grow rice is 30-35,000 m<sup>3</sup>/hectare, and 25-30,000 m<sup>3</sup>/hectare on cotton plantations. These unsound practices of water use are associated not only with the primitive development of irrigation and lack of cost for land and water. This is primarily due to the

incorrect strategy of the former Ministry of Reclamation and Water Management (Minmeliovodkhoz) which in striving for instant successes created large reservoirs and giant canal systems due to the low energy capacity of the reclamation systems and the lack of moisture-collecting technologies in agriculture. These canal systems were to provide for energy-free watering by flooding. The lack of a basin approach and the design of only a given massive of irrigation also to a significant degree resulted in the sad and tragic consequences of the development of irrigation in Kazakhstan. It is also the slow death of the Aral and the drying and pollution of the Balkhash and the desertification and loss of meadows in the deltas and flood plains of rivers. The salinization and alkalization of large areas of land already irrigated are attributed to the use of ancient stores of salts which laid deep in the earth prior to the development of irrigation.

Measures for the universal adoption of chemical methods of agriculture, which Kazakhstan did not avoid, had serious ecological consequences. While the soils are not heavily polluted in the non-irrigated plowed fields, in the irrigation zone pollution of the soil, water, and plants with chemicals has reached critical levels not only on the flood plains, but virtually throughout the entire basin, wherever irrigation is developed. Almost everywhere the irrigated lands and ground water beneath them are polluted with nitrates, fluoride, boron, etc. The presence of significant concentrations of nitrates is associated with unjustifiably high doses and the system of using nitrogen fertilizers added beneath all watered crops. Fluoride pollution of the soils and water stems primarily from the application of phosphorus fertilizers that may contain up to 5 percent fluoride. In some rayons the criminal discharge of sewage containing various toxic pollutants into irrigation sources is permitted.

The situation on crop fields on suburban farms is very alarming. They are presently experiencing tremendous anthropogenic pressure associated with the intensive pollution of the soil and water with industrial wastes—heavy metals and other toxic substances. Thus, on suburban farms in Aktyubinsk, the concentration of some heavy metals was 30-40 times (!) higher than the maximum acceptable quantity in soils and vegetables. Even in the Aksu-Dzhabaglin National Park, which is rather far from the industrial enterprises of Chimkent, the content of lead, cadmium, zinc, and arsenic was three to five times higher than normal in the soils.

These examples suggest the need for a radical review and scientific rationale for using soil resources in Kazakhstan and optimizing the placement of crops with consideration of the modern advances in science.

In many countries of the world complex research has been performed to evaluate the agroecological potential of the territory for the correct organization of farming, the best selection and placement of crops, increasing the harvest of fields, and reducing ecological costs for produce production. By agroecological potential we mean the maximum amount of crop production possible in a

given terrain with the best use of natural resources involved in harvest formation—resources of light, heat, moisture, and soil, and the genetic potential of the plants, etc.

Preliminary assessment of the agroecological potential of the plowed fields in northern Kazakhstan in a zonal respect made it possible to develop a better way of using land resources. In particular, it seems to us that it would be best to reshape the grain raising farms to grain and stock-breeding farms on the dark chestnut soils (10 million hectares). Grain-raising needs to be concentrated on chernozems, the ordinary (7.2 million hectares) and southern (7.3 million hectares), creating a compact grain sowing region and concentrate all stores of organic and mineral fertilizers here to support a deficit-free balance of humus.

The third and chief condition for the effective and productive use of soil resources is the maintaining and restoration of fertility based on the optimization of soil properties, cycles, soil resources, and the development of ecologically clean and economically profitable technologies for raising crops.

In modern agriculture without the use of measures to optimize and manage all soil resources it will be impossible to radically improve soil fertility. Unfortunately, many believe that the problem of high yields can be solved with the intensive use of mineral fertilizers and agrotechnical measures alone. But the use of mineral fertilizers alone will only deteriorate the primary soil properties—the physical, chemical and biological, which determine the level of soil fertility, and will facilitate their pollution. It has been scientifically proven that even when the needs of crops for mineral nitrogen are met, the plants get 50 percent of their needs from biological nitrogen from humus substances and organic matter. This means that the problem of supplying nitrogen to crops cannot be solved with mineral fertilizers alone, as is done in the irrigation zone.

In the non-flood zone where nitrogen fertilizers are hardly used, there is a significant decrease in humus in the soil. As a whole the humus content in the soil in northern Kazakhstan has dropped by 20-30 percent, or during 36 years of using the virgin land, 1.5 billion tons of humus has been lost, which is approximately one-third of its stores in the arable layer. In some rayons of irrigated sierozems, the yearly biological consumption of humus is tied to its mineralization, with carbon dioxide in photosynthesis and nitrogen to support the harvest. Moreover, the technology of raising grain in northern Kazakhstan involves the fallowing of soils as the primary means of combatting weeds, a measure that mobilizes the nutritive elements in the humus, which increases the harvest by 20-30 percent. However, it also involves more intensive wear of the soil humus. The average rate of humus loss on fallowing is 1-1.5 tons per hectare per year.

For example, in the chernozem soils, which are the primary land asset of the highly productive plowed fields in Kazakhstan, where almost 75 percent of gross production of grain crops is grown, the chief index of soil fertility is "humusness", according to research data from the Soil Science Institute, Kazakhstan Academy of Sciences. The research was performed according to a complex program together with the Grain Farming Institute, the humusness in the 0-20 cm arable layer of assimilated virgin land decreased by 27 percent. Typically, the decrease in humus is not limited to the arable layer. During these same years the humus content also decreased in the deeper layers that were not treated. Thus, in the 20-50 cm layer it dropped by 23 percent, and by 16 percent in the 50-100 cm layer. Consequently, the sharp drop in the mass of plant matter entering the soil when the natural biocenosis is displaced results in a decrease in the humusness of the chernozem not only in the arable layer, but also in the entire soil profile.

When studying soil fertility, most researchers paid attention primarily to the humus content in the soil and much less to its quality. Research by the institute demonstrated that not only the total quantity of humus decreases, but also the soil parts that are most active and valuable for fertility: the mobile humic acids and easily hydrolyzed nitrogen. Thus, for a 40 year plowed field, the mobile humic acids in the chernozems decreased by 48 percent, and easily hydrolyzed nitrogen by 45 percent in comparison with the virgin land. The humic acids of the non-hydrolyzed remains that are strongly bound to the mineral portion of the soil, which are 45 percent of the virgin land and 28 percent of the plowed fields, are mobilized.

Soil erosion due primarily to water plays a large role in the drop in soil fertility. We know that water erosion at angles up to 1 percent is the result of deep freezing of the soil in the winter and the unregulated surface discharge of snow melt in the winter, especially against a background of irrigation by snow in fallow fields deprived of plants and stubble. Observations of the Soil Science Institute at the experimental farm of the Grain Farming Institute revealed that there is 24 percent less humus in eroded chernozems than non-eroded ones. Whereas there is 55 tons per hectare of humus in the 0-10 cm layer of virgin land and there is 40 tons per hectare in a 50 year plowed field, there is only 33 tons per hectare in eroded soil. In other words, in the structure of humus losses equal to 15 tons per hectare, almost half can be attributed to erosion losses.

The decrease in the humus potential as a result of farming in the chernozems is accompanied by a decrease in their aggregate composition. The content of water-stable aggregates larger than 0.25 mm in the 0-30 cm layer of the virgin land averages 86 percent, and there is an average of 62 percent in those larger than 1 mm. On a plowed field that was assimilated 54 years ago, they have dropped by 59 and 10 percent, respectively. Thus,

there has been a 6 percent decrease in valuable aggregates larger than 1 mm in the plowed field and a 27 percent decrease in the total number of aggregates larger than 0.25 mm.

The deterioration of the soil structure directly affects soil density. Moreover, over-compacting of the soil by running systems and labor agencies of agricultural engineering are presently an important factor in the degradation of the agrophysical condition. The compaction and decrease in the aggregate reduce the least moisture content of the soil. Thus, if the average least moisture content in the meter layer of virgin soil is 29 percent, then it decreases to 25 percent, or by 26 mm on the plowed field.

Comparative study of the volumetric mass of the virgin and assimilated soils within a single elementary soil geographical range showed that in the plowed field the density of not only the arable, but also the subarable layers increases. This is due to mineralization of the turf and mechanical disturbance of the water stable structure. Soil compaction facilitates a decrease in the yield of spring wheat.

In accordance with the change in the genetic properties of chernozems when they are used for a long time, the agrochemical properties of the soils also change. In particular, the content of total nitrogen in the virgin chernozem in the 0-20 cm layer is 0.21 percent; it is 0.18 percent in the 30 year plowed field, and 0.16 percent in the 50 year plowed field. According to calculations for the past 30 years, 1500 tons of nitrogen were carried away with the harvest, and 2400 tons over the past 50 years. In order to mobilize such a quantity of nitrogen it was necessary to expend 30 tons of humus in the former case and 50 tons in the latter case.

In the irrigation zone soil degradation and the decrease in soil fertility are even more intensive for the reasons indicated above.

Considering the complexity, the multi-factorial, multi-component, and multi-directional nature of the processes in the soil, and the inconsistency of the current approach to assessing soil fertility, in our opinion it is necessary to define the concept of fertility.

In our opinion, the concept of soil fertility, and especially its management and improvement, should be defined with consideration of the current level of science. In building on the idea of academician V. M. Borovskiy about the levels of development of soil processes—terrain, cellular, molecular, and ionic-atomic—the current level may be defined hypothetically as the level of terrain-agroecological management of soil fertility where most attention is given to creating agrocenoses; the management and improvement of basic soil parameters that affect crop harvest and make possible soil conservation, like on the ecological-cellular level; and the management of basic soil parameters of physico-chemical and biological processes in the soil, on the ionic-atomic level.

In our opinion, at the current level of science, for the creation of optimal soil fertility, its restoration needs to occur on the basis of skilled deciphering and improvement of basic parameters, soil properties, and soil processes.

Based on the above, the essence of the basic principles and methods of managing soil fertility include, in the first place, the clear determination of the actual condition of fertility and its parameters, and secondly, establishing the optimal level of its parameters and its management. Based on the summarization of numerous scientific works, the basic indexes of fertility include 50 parameters of chemical, physical, and biological properties that are closely associated with one another and the genesis of the soil itself.

According to data from research performed at the Soil Science Institute, Kazakhstan Academy of Sciences, when beets were sowed in sierozems irrigated by Tasotkelskiy Monolith and 11 of the 50 soil indexes were improved in experiments, the harvest of sugar beets increased by 80-90 percent in comparison with the control. In addition, the amount of humus increased by 20-80 percent, but did not reach its optimal value. The biogenicity, moisture content, and amount of easily hydrolyzed nitrogen and phosphorus noticeably increased (see Table). The latter with the complete exclusion of phosphorus fertilizers is apparently due to a considerable decrease in the pH.

**Table. Basic Soil Parameters of Fertility of Sierozems Irrigated for the 0-30 cm Layer (Tasotkelskiy Monolith, Chu River)**

Parameter	Control	Experimental	Theoretical
Humus, %	1.4	1.6-2.5	3-3.5
pH	8.13	7.7	7-7.5
CO <sub>2</sub>	4.7	6.7	—
Salt content, %	0.1	0.1	0.3
Absorbed sodium, % of total	1.3	1.4	5
Hydrolyzed nitrogen, mg/kg	45	50-55	
P <sub>2</sub> O <sub>5</sub> , mg/kg	22	30-40	
NO <sub>2</sub> , mg/kg	200	100-130	
Volumetric mass, g/cm <sup>3</sup>	1.44-1.7	1.4	1.1-1.2
Water stable structure, %	—	—	60-70
Least moisture content, %	14.5	18.6	20-22
Sugar beet yield, centner/hectare	340	650	900-1000

Another example is that management and optimization of chemical, biochemical, and microbiological processes



that occur in the soil when rice is planted made it possible to radically review the problem of reclaiming heavily salted soils and considerably simplify the assimilation, reclamation, and restoration of fertility through the rice crop.

Under irrigation conditions, the problem of restoration of soil fertility necessitates the removal of water-soluble salts to 0.1-0.3 percent, and metabolic sodium to five percent of the sum of absorbed bases. However, frequently with the presence of certain biochemical and microbiological processes the physical removal alone of the salts does not yield the desired result. It has been found that under conditions of rice sowing on alkaline soils, the restoration of soil fertility is heavily affected by boron compounds, pathogenic microflora, the alkaline environment of the biochemical nature and deficit of some microelements, the poor oxygen supply in some phases of plant development, bioelectrical processes, etc., all of which are extremely toxic to the plants.

Negative biochemical and microbiological processes are intensively displayed when there is a shortage of mobile zinc in the soil; a given portion of edaphic zinc is necessary to suppress processes of biological alkalization, pathogenic microflora, and boron sickness.

Thus, the explanation of the nature of these soil processes made it possible to determine the most effective means for their removal.

Adding zinc to the soil will not only compensate for the shortage but will also increase the salt resistance of plants and their ability to assimilate nutrients from highly mineralized solutions, and improve their accessibility and photosynthesis activity of rice. On this basis a technology was developed for raising rice on highly saline soils with a salt content of up to 6-8 percent. An irrigation method was developed that made it possible to regulate the oxygen and the fertilization system in the root layer, and the need for flowing and discharge of irrigation water was eliminated. The chief advantage of this technology is that it is ecological and irrigation water is conserved, with a reduction in the irretrievable water use from 35 to 16,000 m<sup>3</sup>/hectares per year. Also, there is a 30-40 percent increase in the cropping capacity.

Analysis of the current status of soil fertility in agricultural areas suggests that the introduction of various intensive technologies, the essence of which lies in the preference for individual methods rather than their systems, has not produced the desired results.

The unsatisfactory current status of soils in Kazakhstan and their water-physical, physico-chemical, biochemical, and microbiological properties and the disregard of soil

processes in the soil make the return from such technologies ineffective, that is, without a radical improvement of these properties, and without consideration of soil processes stemming from the genetic aspects of each type of soil, we cannot anticipate a significant increase in productivity from any technology.

The current status of soil in agricultural areas subjected to biological and chemical degradation necessitates the setting of a goal—to develop the scientific basis of ecologically clean biological agriculture and developments in technology for raising crops that necessitate reviewing the practice of fertilizer and chemical use.

Organic agriculture has begun to be widely used in western countries to produce quality, ecologically clean produce. In connection with this, the concept of "effective regress" has appeared in the scientific vocabulary of these countries. Scientific developments at the Soil Science Institute, Kazakhstan Academy of Sciences in this direction suggest that by preserving soil fertility we can raise ecologically clean produce.

In summing up the above, we may note that:

1. Fertility is an integral index reflecting the natural, historical, and socioeconomic conditions as well as the level of scientific and technical progress. Therefore, the chief goal of science is to develop the methods and technologies of forming highly productive soils with consideration of the bioclimatic potential and genetic aspects of the soil and crops;
2. Considering the priority nature of solving ecological problems, all agricultural systems should meet the primary need—in accordance with objective laws of scientific agriculture, establish the correct balance of substances and energy in an agroecosystem and the optimal relationships in the structure of the crops, without allowing overload of the soil and other elements of the agroterrain;
3. In order to solve these problems it is necessary to develop a remedial complex scientific and technical program for Kazakhstan for the protection and efficient use of soil resources in agriculture with the performance of experimental works with consideration of the genetic aspects of the soils, crop raising, and natural conditions.

Report given at the general session of the Biological Sciences Department, Kazakhstan Academy of Sciences, and the Department of Agricultural Reclamation and Forestry, Kazakhstan Academy of Agricultural Sciences, "Soil Fertility Problems", November 26, 1991)

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### Prostaglandin Synthesis by Wood-Degrading Basidiomycetes

937C0041B Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 322 No 3, Jan 92 (manuscript received 18 Oct 91) pp 604-606

[Article by A.N. Kapich, N.G. Geling, A.V. Karetelishv and A.G. Lobanok, academician, Belarus Acad. Sci., Institute of Microbiology, Belarus Academy of Sciences, Minsk; All-Union Scientific Research Institute of General and Forensic Psychiatry imeni V.P. Serbskiy, Moscow; UDC 579.222:577.125.33]

[Abstract] Screening studies on several species of wood-degrading basidiomycetes demonstrated their capability for oxidizing arachidonic acid and, in some cases, formation of prostaglandins and thromboxanes B (TXB). In particular, the yield of TXB<sub>1</sub> reached 6 percent in *Panus tigrinus*, suggesting the presence of a unique thromboxane synthetase for conversion of dihom- $\gamma$ -linolenic acid. In general, the highest levels of arachidonic acid oxidation were displayed by *Panus tigrinus* and *Fomes fomentarius*, while the corresponding enzymatic activities of *Phanerochaete chrysosporium* and *Fomitopsis pinicola* were less pronounced. Figures 2; references 13: 10 Russian, 3 Western.

### Genetic Transformation of Alfalfa by *Agrobacterium tumefaciens* Ti Plasmids

937C0058A Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 319 No 6, Aug 91 (manuscript received 03 Jun 91) pp 1473-1476

[Article by Ye.V. Deneyko, M.I. Rivkin, M.L. Komarova, A.V. Vershinin and V.K. Shumnyy, Institute of Cytology and Genetics, Siberian Department, USSR Academy of Sciences, Novosibirsk; UDC 575.22]

[Abstract] Alfalfa plants were transformed by Ti plasmids of *Agrobacterium tumefaciens* bearing human  $\beta$ -interferon gene and bacterial neomycin phosphotransferase (NPTII) indicator gene, yielding the first reported transgenic alfalfa plants. The recombinant pG11 and pG21 plasmids were constructed using co-integrated vector pGSH160, transferred from *E. coli* to *A. tumefaciens* and the latter used to infect alfalfa leaf disks. The efficiency of transformation with both plasmids was on the order of 36.2-37.6 percent. Of the 38 transgenic plants that were produced, 26 contained pG11 DNA and 12 pG21 DNA, with all expressing NPTII activity to some degree. These findings demonstrated the suitability of alfalfa as a vehicle for studies on expression and inheritance of foreign genes in transgenic plants. Figures 4; tables 1; references 10: 1 Russian, 9 Western.

### Molecular Basis of Influenza Virus Drug Resistance

937C0058B Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 319 No 6, Aug 91 (manuscript received 30 May 91) pp 1480-1484

[Article by V.M. Blinov, S.M. Resenchuk, V.A. Karginov, V.P. Mishin, K.N. Kozeletskaya, L.S. Sandakhchiyev, corresp. member, USSR Acad. Sci., and O.O. Kiselev, All-Union Scientific Research Institute of Influenza, Leningrad; All-Union Scientific Research Institute of Molecular Biology, "Vektor" Scientific Research Industrial Association, Koltsovo, Novosibirsk Oblast; Novosibirsk Institute of Bioorganic Chemistry, Siberian Department, USSR Academy of Sciences; Institute of Clinical and Experimental Medicine, Siberian Department, USSR Academy of Medical Sciences, Novosibirsk; UDC 578.832.1578.2]

[Abstract] Protein analysis was performed on influenza viruses A/Victoria/35/72 (H2N2) and A/USSR/90/77 (H1N1) displaying resistance to rimantadine and deitoforin [as published] following long-term cell culture in the presence of these agents. The study concentrated on detailed analysis of viral M proteins encoded by the seventh segment of the viral genome in the wild and resistant viruses. The results indicated that resistance to antivirals was correlated with mutations in protein M2 (V  $\rightarrow$  A) and the putative M3 protein (N  $\rightarrow$  S), changes that diminished or prevented drug binding but did not affect viral binding to cellular receptors and, hence, infection. Binding of the antivirals to wild-type viruses induced conformational changes in the M proteins sufficient to impair their binding to cellular receptors and, hence, precluded infection. Figures 2; references 6: 4 Russian, 2 Western.

### Contrasting Temperature Exposures in Adaptation of Pilots to Hot Climates

937C0073A Moscow FIZIOLOGIYA CHELOVEKA in Russian Vol 18 No 4, Jul-Aug 92 (manuscript received 30 Jan 91) pp 23-29

[Article by V.I. Kopanov, V.N. Ishutin and V.Yu. Chprasov, Military Medical Academy imeni S.M. Kirov, St. Petersburg; UDC 612.014.43.001.72]

[Abstract] Based on the observations that the temperature contrasts experienced in a sauna appear to induce adaptation to elevated temperatures, an analogous regime was tested for enhancing heat tolerance in pilots. The study involved eight clinically healthy males 25-39 years old. Thermal adaptation involved three 10 minute daily exposures to air temperatures of 90°C, 10-12 percent relative humidity, for eight days. During the first one to two minutes of the 10 minute intervals between heat exposure the group took a shower at 15-17°C. Orthostatic, statokinetic, and hypoxic tests on the experimental and control subjects showed that "adapted" individuals performed better after adaptation when placed under thermal stress (40°C; 30 percent relative

humidity), e.g., statokinetic stability was 12-13 percent higher in the experimental subjects, and water loss was some 20-28 percent lower. Accordingly, these observations indicate that thermal adaptation is a feasible approach to improving pilot performance in hot climates. Figures 3; tables 1; references 22: 20 Russian, 2 Western.

**Neurohumoral Responsiveness of Cosmonauts After 365-Day Space Flight**

937C0073B Moscow FIZIOLOGIYA CHELOVEKA in Russian Vol 18 No 4, Jul-Aug 92 (manuscript received 16 Nov 90) pp 30-38

[Article by N.A. Davydova, Institute of Biomedical Problems, Moscow; UDC 612]

[Abstract] Impact of space flight on neurohumoral dynamics of two cosmonauts was assessed during recovery from a 365 space flight aboard a Mir space station. Despite individual variations, analysis of urine and/or blood samples demonstrated marked activation of the sympathetic-adrenomedullary, serotonergic and histaminergic systems immediately on landing (Day 0). One day after landing the functional level of the sympathetic-adrenomedullary system fell to below the preflight baseline, increasing thereafter and resulting in hypermetabolism of catecholamines. Both cosmonauts evidenced modest activation of cholinergic mechanisms. After one week of terrestrial readaptation the parameters of interest had not restabilized to preflight baselines. Accordingly, the protracted course of postflight recovery of neurohumoral mechanisms suggests that specific preflight prophylactic measures should be implemented vis-a-vis neurohumoral systems. Figures 3; tables 2; references 22: 12 Russian, 10 Western.

**Contractility of Human Triceps Surae in Simulated Weightlessness**

937C0073C Moscow FIZIOLOGIYA CHELOVEKA in Russian Vol 18 No 4, Jul-Aug 92 (manuscript received 10 Nov 90) pp 39-46

[Article by Yu.A. Koryak, "Sport" Central Scientific Research Institute, Moscow; UDC 612.741.014.477-064]

[Abstract] The impact of simulated weightlessness on contractility of triceps surae muscles was analyzed in six males (31-45 years old; 68-91 kg in weight; 164-178 cm in height). Weightlessness was simulated by a 120 days bed confinement, a regimen that prolonged the duration of a single isometric twitch from 120 to 136 msec ( $p < 0.01$ ), total contraction from 440 to 540 msec ( $p < 0.001$ ), and the relaxation  $t_{1/2}$  from 92 to 100 msec ( $p < 0.05$ ). Concomitantly, other changes included a decrease in the the various force parameters by 33.7-45.5 percent ( $p < 0.05-0.01$ ) and a 3.6 percent increase in the maximum force/isometric force ratio. Finally, the "strength deficit" of the triceps surae after 120 days of

bed confinement increased by 60 percent ( $p < 0.001$ ). The data were consistent with bed rest-induced deterioration in the "active state" of the triceps surae due to atrophy and diminished "central" input. Figures 4; references 40: 8 Russian, 32 Western.

**Monitoring of Black Sea Modiolous Phaseolus Populations in Kalamitskiy Bay**

937C0092A Kiev GIDROBIOLOGICHESKIY ZHURNAL in Russian Vol 28 No 4, Jul-Aug 92 (manuscript received 16 Oct 91) pp 23-30

[Article by N.N. Tereshchenko, G.G. Polikarpov and T.P. Kovalenko, Institute of Biology of Southern Seas, Ukrainian Academy of Sciences, Simferopol; UDC 574.543.53:564(262.5)]

[Abstract] The ecosystem of the Black sea mollusc Modiolous phaseolus in the Kalamitskiy Bay was assessed in 1989 for comparison with observations made in the sixties and seventies. Population measurements made at distances of 50-100 m from the shoreline at depths of 50-300 m revealed a basic biomass shift toward shallower waters. While earlier studies demonstrated that M. phaseolus occupied depths of 60-125 m with a peak at ca. 80 m. The more recent findings were that, depending on location in the bay, M. phaseolus distribution was limited to depths of 55-110 m. M. phaseolus has completely disappeared from the eastern part of the bay and has been markedly reduced in the western section. The negative changes were not attributed to a shift in the hydrogen sulfide boundary or redox conditions, but rather to anthropogenic intervention which primarily affect the shelf region. Depletion of P. phaseolus provides further evidence of deteriorating Black Sea ecology since this hydrobiont has an important role as a biofilter and in biosedimentation processes, as well as serving in the food chain of bottom-feeding fish. Figures 4; tables 2; references 9: Russian

**Self-Purification in Lake Baikal**

937C0092B Kiev GIDROBIOLOGICHESKIY ZHURNAL in Russian Vol 28 No 4, Jul-Aug 92 (manuscript received 24 Jun 91) pp 47-56

[Article by K.K. Votintsev (dec.), Baikal Ecological Museum, Siberian Branch, Russian Academy of Sciences, Listvyanka, Irkutsk Oblast; UDC 574.633(285.2)]

[Abstract] Assessment of the rate of organic matter decomposition in Lake Baikal has shown that normally 75 percent is oxidized during the first year of ingress, with the remainder decomposes over the following five to six years. However, in recent years development of the paper mill industry along the shores of Lake Baikal has destroyed the delicate natural balance by effluent discharge from the plants. If industrial pollution continues unabated, oxygen resources of the lake will be overtaxed, then depleted, and the entire ecological balance may sustain irreversible damage. Studies that began in 1956



point to a gradual but serious loss of the lake's capacity for decomposition of organic matter. Tables 4; references 18: 17 Russian, 1 Western.

#### Efficiency of Cladocera Sp. in Bioassays

937C0092C Kiev *GIDROBIOLOGICHESKIY ZHURNAL* in Russian Vol 28 No 4, Jul-Aug 92 (manuscript received 12 Jul 91) pp 76-81

[Article by E.P. Shcherban, Institute of Hydrobiology, Ukrainian Academy of Sciences, Kiev; UDC [574.64:595.324](28)]

[Abstract] Several cladoceran species were tested for their suitability in assaying water toxicity, using waters collected from the Kiliy branch of the Danube in the vicinity of Vilkovo, Ukraine. The study involved assessment of viability, fertility, and behavioral parameters in response to common pesticide contaminants. The results showed considerable species variation in susceptibility to common water pollutants among *Daphnia magna*, *D. longispina*, *Moina macrocopa*, *M. rectirostris*, *Scapholeberis mucronata* and *Ceriodaphnia quadrangula*. Nevertheless, while every species tested was suitable in some cases, *D. magna* and *D. longispina* were shown to be most susceptible to the adverse effects of pollutants and thus provided the most sensitive microbioassays. Tables 1; references 23: 21 Russian, 2 Western.

#### Impact of Hydrochemical Parameters on Sr-90 and Cs-137 Accumulation in Fish

937C0092D Kiev *GIDROBIOLOGICHESKIY ZHURNAL* in Russian Vol 28 No 4, Jul-Aug 92 (manuscript received 16 Oct 91) pp 82-87

[Article by L.A. Milakina, A.B. Smirnov, T.A. Antonova and G.M. Aksenov, Experimental Station, "Mayak" Manufacturing Association, Chelyabinsk; UDC [574.64:597]:556.531.4]

[Abstract] A study was made of the hydrochemical characteristics of lake water as a factor in bioaccumulation of Sr-90 and Cs-137 in fish in the eastern Urals region, site of the 1957 Kyshtym nuclear accident. Construction of 3-D regression maps and x-y graphs for concentration coefficients was based on SURFER [expansion not given] programs for regression analysis, utilizing data on radionuclide levels in fish, and information on water pH, temperature, and concentration of calcium, potassium, sodium, and total salt content. The resultant findings provide the means and information for evaluation of Sr-90 and Cs-137 levels in perch and

roach for hydrocarbonate-type lakes prevalent in the eastern Urals. Figures 4; tables 2; references 9: 8 Russian, 1 Western.

#### Polycyclic Aromatic Hydrocarbons (PAH) in Danube Waters

937C0092E Kiev *GIDROBIOLOGICHESKIY ZHURNAL* in Russian Vol 28 No 4, Jul-Aug 92 (manuscript received 04 Nov 91) pp 88-92

[Article by M.G. Korotkov, N.A. Klyuyev, O.G. Tarasova, N.V. Murenets and A.M. Tsvetkova, Institute of Evolutionary Animal Morphology and Ecology, Russian Academy of Sciences, Moscow; UDC [543.3:574.63](282.243.7)]

[Abstract] Danube waters were analyzed for PAH levels at 25 sites in different countries in the September 12 - October 9, 1990, timeframe as part of Blue Danube-90 project. Analytical techniques relied on HPLC in combination with fluorometric detection. The results demonstrated extensive range of concentrations for 13 common PAHs, with the total levels ranging from 103.7 to 4280.1 ng/L. In general, highest concentrations of the carcinogen 3,4-benzpyrene—exceeding threshold limit value (TLV)—prevailed in the vicinity of port city of Reni (Ukraine), at the mouth of Sava River and Vyshgorod. At Reni the concentrations of 3,4-benzpyrene exceed the TLV some 50-fold, findings attributed to the city's heavy waterborne traffic. Figures 2; tables 2; references 5: 2 Russian, 3 Western.

#### Nephelometric Determination of Concentration and Size of Suspended Particles in Water

937C0092F Kiev *GIDROBIOLOGICHESKIY ZHURNAL* in Russian Vol 28 No 4, Jul-Aug 92 (manuscript received 21 Jun 91) pp 100-103

[Article by E.A. Mesropyan, A.G. Ovanesyan and N.N. Shalovenkov, "Analitpribor" Scientific Industrial Association, Tbilisi; Institute of Biology of Southern Seas, Ukrainian Academy of Sciences, Sevastopol; UDC 551.461.8(261)]

[Abstract] A rough schematic is presented of a photoelectric nephelometer manufactured by Analitpribor (Georgia) for particle size and concentration analysis in water samples. Testing has shown that this instrument offers a number of advantages over Coulter counters, including the use of a single cuvette for all measurements and the fact that measurements are not affected by conductivity of the seawater samples. The instrument measures presumed spherical particles ranging in size from 5 to 500  $\mu\text{m}$  up to a concentration of 1400 particles/cm<sup>3</sup>. Figures 1; references 13: 10 Russian, 3 Western.

**Fauna and Certain Features of the Ecology of Dominant Species of Blood-Sucking Mosquitoes in Irrigated Areas of Uzbekistan**

937C0051B Moscow MEDITSINSKAYA PARAZITOL  
OGIYA I PARAZITARNYYE BOLEZNI in Russian  
No 4, Jul-Aug 91 [manuscript submitted 1 Feb 90]  
pp 27-31

[Article by Ye. V. Demyanov, F. V. Gitsu, V. P. Dremova, A. M. Mitrofanov (deceased), N. Ya. Yun, V. V. Labzin, Institute of Medical Parasitology and Tropical Medicine imeni Ye. I. Martynovskiy, USSR Ministry of Health, Moscow; UDC 576.895.771:614.449.57]

[Abstract] With an eye to developing an efficient technique for combating mosquitoes on reclaimed and irrigated lands in Uzbekistan, the researchers conducted a 1981-1989 study of mosquito fauna and the seasonal and diurnal activity of the dominant species in the Golodnaya and Dzhizakskaya steppe regions, which are irrigated with water from the Southern Golodnosteppe Canal. The dominant species of mosquito were *Aedes caspius*, *Culex modestus*, *Cx. pipiens*, *Cx. pusillus*, *Anopheles pulcherrimus*, *An. hyrcanus*, *Culiseta annulata*, and *Mansonia richiardii*. The researchers concluded that mosquitoes continue to breed in temporary puddles and pools of water that are formed as a result of the inefficient use of water, malfunctioning irrigation systems, and tardy cleanup operations. Most of the mosquito populations in settlements are on stagnant puddles, where breeding takes place one to three days after the puddles are formed. The density of larvae can reach a figure of several thousand specimens per square meter (depending on the type of pool). The period in which mosquitoes actively attack lasts six to seven months, with the population of attacking mosquitoes in July-September as high as 100 per human. The presence of the *Anopheles* genus threatens the complication of the epidemiological situation with respect to malaria. Figures 3, references 12: 10 Russian, 2 Western.

**Seasonal Variations in Resistance to and Irritability With Regard to Insecticides in Malarial Mosquitoes in Karakalpakiya**

937C0052A Moscow MEDITSINSKAYA  
PARAZITOLOGIYA I PARAZITARNYYE BOLEZNI  
in Russian No 4, Jul-Aug 91 [manuscript submitted  
22 Feb 90] pp 9-12

[Article by N. N. Sorokin, T. A. Adamishina, A. P. Stepnov, V. L. Ivanova, Yu. V. Yermishev, Institute of Medical Parasitology and Tropical Medicine imeni Ye. I. Martynovskiy, USSR Ministry of Health, Moscow; UDC 576.895.771.04:615.285.7].076.7]

[Text] The seasonal variability in the resistance of malarial mosquitoes to DDT and hexachlorane was first detected in the 1950's and has been noted often since then because of that in various species.<sup>3,5-7</sup> In 1988, in the *Anopheles sacharovi* in Azerbaijan, a variation was found in the level of irritability with regard to certain

insecticides over the course of a season, a change possibly due to the way the insecticides were applied.<sup>1</sup> From March through November 1989, we made observations of sensitivity and irritability among *An. martinius* and *An. pulcherrimus* with regard to malathion, phenitrothion, propoxur, and DDT in Karakalpakiya. The work represents the first such work done in the republic.

Resistance was determined with the standard WHO procedures,<sup>2</sup> and irritability, with a modified procedure.<sup>4</sup> We used standard WHO insecticide paper (malathion, 5 percent; phenitrothion, 1 percent; propoxur, 0.1 percent, DDT, 4 percent). Experiments with *An. martinius* were done four times over the course of the season: in late March/early April (migration of the impregnated females from winter shelters to day stopovers and the beginning of blood-sucking), in late July/early August (the summer population peak), in late August/early September (the autumnal decline in population and the appearance of the first diapausing specimens), and in November (diapause). We were able to ascertain resistance and irritability among *An. pulcherrimus* with regard to insecticides among *An. pulcherrimus* only twice—in late July/early August and in late August/early September—because the stage III larva of that species is in hibernation, and the summer population peak of the imago is brief. Satiated females at day stopovers and obese females in hibernation were collected in the Takhtakupyrskiy Rayon.

Our findings are presented in tables 1-4. *An. martinius* has a complete sensitivity to malathion and phenitrothion that remains throughout the season; the survival of some specimens who come in contact with those insecticides in November (Table 1) is apparently due to an elevated tolerance, since all those specimens were in a depressed state by the end of the experiment. A minute level of resistance to propoxur was found among *An. martinius*, and it changed little over the course of the season. A comparison of deaths by the end of the exposition and deaths within 24 hours gives reason to believe that that resistance is based on the knock-down mechanism; only in April were deaths within an hour fewer than those within 24 hours, but then we managed to observe the knock-down effect in individual species in the determination of irritability with regard to propoxur. An analogous phenomenon was found in *An. superpictus* and *An. hyrcanus* in Tajikistan (those data are ready for publication). Resistance to DDT in *An. martinius* is almost completely absent when it comes out of hibernation, but by the end of July, it reaches a moderately high level (27.1 percent) and then gradually declines toward the fall (consistently, at  $p > 0.999$ ); the latter fact is consistent with the data for other species.<sup>3,5,6</sup> The strong rise in tolerance to all preparations, except propoxur, among hibernating mosquitoes should also be noted (Table 1, deaths within an hour). The biological sense of that is obvious: the hibernating generation is the most susceptible link in the yearly cycle and needs reliable protection from a broad spectrum of adverse factors. Physiologically, that is probably due to lower metabolic activity and obesity.

## Resistance of Malarial Mosquitoes to Insecticides in Takhtakupyrskiy Rayon

Species	Insecticide	Date	Number of mosquitoes in experiment	Percentage of active or living specimens		Temperature, °C
				After 1 hour (end of exposition)	After 24 hours	
<i>An. martinius</i>	Malathion	10 Apr	80	0	0	20-22
		30 Jul	60	—	0	27
		28 Aug	80	20.0	0	27
		19 Nov	80	91.3	7.5	17.5
	Phenitrothion*	6 Apr	80	42.5	0	20-22
		31 Jul	83	—	0	28.5
		28 Aug	80	30.0	0	27
		19 Nov	80	97.5	2.5	17.5
	Propoxur	10 Apr	74	12.2	8.1	20-22
		31 Jul	75	0	4.0	28.5
		26 Aug	80	0	7.5	26.5
		17 Nov	80	6.3	7.5	18
	DDT	6 Apr	80	1.3	1.3	20-22
		7 Aug	59	—	27.1	29
		26 Aug	80	60.0	25.0	26.5
		17 Nov	80	87.5	20.0	18
<i>An. pulcherrimus</i>	Malathion	3 Aug	78	—	0	26
		1 Sep	80	15.0	0	25.5
	Phenitrothion*	3 Aug	80	—	0	26
		1 Sep	80	40.0	0	25.5
	Propoxur	1 Aug	80	—	0	27
		31 Aug	80	0	0	26
	DDT	1 Aug	79	—	20.3	27
		31 Aug	80	31.3	0	26

Note: *An. martinius* was collected in Takhtakupyr; *An. pulcherrimus*, in Marzhankul (for the purpose of ascertaining sensitivity and irritability with respect to malathion and phenitrothion) and in Turtaul (for the purpose of ascertaining sensitivity and irritability with respect to propoxur and DDT)

\*length of exposition with phenitrothion, two hours

*An. pulcherrimus* is completely sensitive to all insecticides and is moderately tolerant of malathion, phenitrothion, and DDT; death from propoxur comes within 15-20 minutes. We attribute the survival of 20.3 percent of specimens who come in contact with DDT in early August to elevated tolerance, since the complete disappearance of actual resistance of such a level over an hour's time is not likely. Nevertheless, seasonal variations in the level of resistance to DDT has been described for that species.<sup>3</sup>

In both species, there are substantial seasonal variations in irritability with regard to all four preparations (tables 2 and 3). On the whole, both *An. martinius* and *An. pulcherrimus* show the highest irritability with regard to DDT. Their irritability with regard to malathion is considerably lower; to propoxur, still lower; and to phenitrothion, the lowest. Those relationships are maintained throughout the observation period, the seasonal variability notwithstanding.

Seasonal Variations in Irritability With Respect to Insecticides Among *An. martinus* in Takhtakupyrskiy Rayon

Insecticide	Date	Collection site	Not irritable, percent	Moderately irritable		Highly irritable		Temperature, °C
				Percentage of specimens	Average number of flights	Percentage of specimens	Average number of flights	
Malathion	28-30 Mar	Takhtakupyr	8.0	66.0	5.0 +/- 0.3	26.0	16.8 +/- 1.5	20-22
	28 Jul	"	58.0	20.0	3.2 +/- 0.5	22.0	14.6 +/- 1.7	27
	28-29 Aug	"	34.0	40.0	4.5 +/- 0.4	26.0	23.8 +/- 2.8	28
	15 Nov	Sovkhoz Frunze	8.0	82.0	3.9 +/- 0.3	10.0	11.8 +/- 0.7	18
Phenitrothion	28-30 Mar	Takhtakupyr	20.0	68.0	4.8 +/- 0.3	12.0	15.1 +/- 1.0	20-22
	31 Jul	"	88.0	12.0	2.5 +/- 0.8	0		28.5
	29 Aug	"	82.0	10.0	4.0 +/- 0.5	8.0	17.5 +/- 3.4	28
	16 Nov	Sovkhoz Frunze	26.0	72.0	3.7 +/- 0.4	2.0	10	17.5
Propoxur	1 Apr	Takhtakupyr	30.0	62.0	4.8 +/- 0.3	8.0	13.5 +/- 2.6	20-22
	29 Jul	"	64.0	32.0	2.4 +/- 0.4	4.0	12.5 +/- 0.5	27
	28 Aug	"	48.0	50.0	5.6 +/- 0.5	2.0	14	28
	15 Nov	Sovkhoz Frunze	16.0	84.0	3.7 +/- 0.3	0		17.5
DDT	4 Apr	Takhtakupyr	0	38.0	5.7 +/- 0.3	62.0	18.4 +/- 1.4	20-22
	25-26 Jul	Marzhankul	38.0	36.0	4.9 +/- 0.7	26.0	14.7 +/- 1.7	28.5
	29 Aug	Takhtakupyr	16.0	34.0	5.5 +/- 0.7	50.0	18.4 +/- 1.1	29
	15 Nov	Sovkhoz Frunze	2.0	90.0	3.2 +/- 0.3	8.0	11.3 +/- 0.8	17.5

Seasonal Variations in Irritability With Respect to Insecticides Among *An. pulcherrimus* in Takhtakupyrskiy Rayon

Insecticide	Date	Collection site	Not irritable, percent	Moderately irritable		Highly irritable		Temperature, °C
				Percentage of specimens	Average number of flights	Percentage of specimens	Average number of flights	
Malathion	3 Aug	Turtauil	46.0	44.0	2.5 +/- 0.4	10.0	14.8 +/- 1.5	27
	26 Aug	"	60.0	36.0	3.7 +/- 0.6	4.0	15.0 +/- 4.0	28
Phenitrothion	4 Aug	"	82.0	18.0	0.9 +/- 0.4	0		28
	3 Aug	Takhtakupyr	94.0	6.0	1.7 +/- 0.9	0		26
Propoxur	1 Aug	Turtauil	70.0	30.0	0.9 +/- 0.4	0.0		29
	27 Aug	Marzhankul	78.0	22.0	3.3 +/- 0.4	0		26
DDT	25-27 Jul	"	24.0	36.0	4.1 +/- 0.6	40.0	19.7 +/- 3.6	28.5
	31 Aug	"	20.0	50.0	5.8 +/- 0.5	30.0	15.5 +/- 1.0	25

The nature of that variability with regard to all the toxins in each species turned out to be identical. In *An. martinus* (Table 2), irritability with respect to malathion, phenitrothion, propoxur, and DDT was very high in the spring; but it fell by the end of July to a low or moderate level, after which it began to rise, reaching levels in November (in diapausing specimens) that were close to those in the spring. Most instructive here are changes in the percentages of those without irritability and average values for the number of flights among moderately irritable specimens. The rise or decline of the last index was usually consistent and was usually correlated with

the dynamics of distribution in terms of degree of irritability (DDT was an exception).

The considerable reduction in the percentages of highly irritable specimens should also be noted, as should the consistent decline of the average number of flights among specimens moderately or highly irritable with regard to all the preparations in November ( $p = 0.99$  or  $p > 0.999$ ), which was due to reduced activity levels among diapausing mosquitoes (the air temperature during the experiments in the spring was similar to that in November).



In *An. pulcherrimus* (Table 3), irritability with regard to the insecticides in late July/early August was low or moderate; and by early September, unlike in *An. martinius*, it was lower yet. The exception was DDT: the percentage of mosquitoes not irritated by it dropped only negligibly, the percentage of highly irritated specimens dropped markedly, and the average number of flights rose consistently among moderately irritated specimens and showed no consistent change among highly irritated specimens. Thus, irritability with regard to DDT remained much as before, at a rather high level. What should also be noted is the consistent rise ( $p > 0.999$ ) in the number of flights among specimens moderately irritated by propoxur; variations of that figure for phenitrothion and malathion were inconsistent.

The total number of flights when there was contact with all the insecticides varied consistently over the course of the season in *An. martinius* (Table 4). The November values for that figure were consistently lower than not only the spring values, but sometimes also the August values (for malathion and DDT) and even July values (for DDT), although, on the whole, spring and fall levels of irritability in *An. martinius* were similar, and they were far in excess of those of summer. Such an inconsistency was due to lower motor activity of diapausing mosquitoes, and it is a graphic indication of the lack of objectivity of the irritability criterion adopted by WHO.<sup>2</sup>

Seasonal Variations in the Total Number of Flights of Malarial Mosquitoes in Contact With Insecticides

Insecticide	<i>An. martinius</i>		<i>An. pulcherrimus</i>	
	Date	Total Number of Flights	Date	Total Number of Flights
Malathion	28-30 Mar	8.5 +/- 1.0	—	—
	28 Jul	3.9 +/- 0.9	3 Aug	2.6 +/- 0.6
	28-29 Aug	8.1 +/- 1.5	26 Aug	2.0 +/- 0.5
	15 Nov	4.4 +/- 0.5	—	—
Phenitrothion	28-30 Mar	4.8 +/- 0.7	—	—
	1 Jul	0.3 +/- 0.1	4 Aug	0.2 +/- 0.1
	29 Aug	1.8 +/- 0.7	30 Aug	0.1 +/- 0.1
	16 Nov	2.9 +/- 0.4	—	—
Propoxur	1 Apr	4.1 +/- 0.6	—	—
	29 Jul	1.4 +/- 0.4	1 Aug	0.3 +/- 0.1
	28 Aug	3.2 +/- 0.5	27 Aug	0.8 +/- 0.2
	15 Nov	3.1 +/- 0.3	—	—
DDT	4 Apr	13.6 +/- 1.3	—	—
	25-26 Jul	5.7 +/- 1.0	25-27 Jul	9.4 +/- 1.9
	29 Aug	11.1 +/- 1.2	31 Aug	7.6 +/- 0.9
	15 Nov	3.8 +/- 0.4	—	—

The principal features of the seasonal variations we found in irritability were the lack of a connection with what class the insecticide belonged to and the singularity of the seasonal dynamics in each species. What could that be due to?

The use of DDT against mosquito imagoes in Takhtakurskiy Rayon stopped back in the 1960's. Only in 1988 were loft areas in the central farm of the Marzhankul Sovkhoz treated with DDT. In recent years,

widespread agricultural application of the following pesticides has been done: propachlor, bazagran, saturn, ordram, ricid-2, zolon, and polycarbacin. The characteristics of the pesticides and the manner in which they are applied are presented in Table 5. In addition, in 1982-1986, aerial spraying of GKhtTsG alfafa was done on a large scale against *Caliptamus*. In the central quarter of the rayon center Takhtakupyr, secondary areas are treated with chlorofos against flies annually and on a regular basis; based on long-term observations, mosquitoes are almost never encountered there.

Use of Agricultural Plant Protection Agents in Takhtakupyrskiy Rayon in 1982-1989

Preparation	Active ingredient	Class	Purpose	Crop	Year of application	Time of year of application
Propachlor	Propanid	Haloid-substituted analide of carbonic acid	Herbicide	Rice	1982-1989	Spring (before shoots)
Bazagran	Bentazon	Thiodiazinone derivative	"	Grains, clover	1983, 1986, 1988, 1989	April, May, mid-June
Saturn	Thiobencarb	Thiocarbamate	"	Rice	1982-1989	"
Ordram	Molinate	"	"	"	1986-1989	"
Ritsid-2	Isopropyl analog of ritsid	FOS	Fungicide	Rice (perikulyariroz)	1989	Every 10 days until the end of June
Polycarbacin	MetiramDithiocarbamate	"	"	1989	"	"
Zolon	Fozalon	FOS	Insecticide	Cotton, potatoes, tomatoes	1989	Summer, as needed

In 1983-1985, in July-August, personnel of the Karakalpak expedition of VNIIDiS [not further expanded] treated the stopping points of *An. martinius* with methathion (phenitrothion), aktellik (pyrimiphosme thyl), carbofos (malathion) and DDVF on a limited scale (individual settlements of the Sovet Uzbekistan and Marzhankul sovkhoses). In 1986-1987, only methathion was used, in mid-April. In 1988, four settlements of the Sovet Uzbekistan Sovkhoz and the central farm of the Takhtakupyr Sovkhoz, which is adjacent to the rayon center, were thoroughly treated with the Indian SP malathion, in early August. Finally, in 1983, 1986, and 1987, some of the breeding areas for mosquitoes were treated with methathion, carbofos, and aktellik. In 1989, only pyrethroids were used for the treatments. Carbamates were not used at all for those purposes.

It is obvious that resistance and irritability with respect to DDT among mosquitoes of the Takhtakupyrskiy Rayon is a remaining phenomenon. Irritability with respect to malathion may be due to the treatment of areas with carbofos and especially Indian malathion; the irritability with respect to phenitrothion may be due to the use of methathion. Antilarval measures involving the use of methathion, carbofos, and aktellik have been on a small scale and have not resulted in any resistance. The negligible level of resistance to propoxur may be due to the use of saturn and ordram. Irritability with respect to propoxur seem to have a spontaneous character and is related to the fumigant properties of the preparation, since spring treatments with saturn and ordram could hardly have a serious effect on the imago of *An. martinius* and could have no effect whatsoever on *An. pulcherrimus*, whose larvae hibernate.

The analysis of the seasonal methods of treatment indicates that the nature of the seasonal variations in irritability is not at all connected with them. Malathion and carbofos have been used in July-August; phenitrothion (methathion) in April as well; carbamates, not at all; and DDT, not since the 1960's. Irritability with respect to all those toxins changed identically in each of the two

species—at least in 1989. Consequently, other factors are at work here. One of them could be the hibernation phase—pointing to that is the rise in irritability among the *An. martinius* (the imago hibernates) and the decline of it in *An. pulcherrimus* (the larva hibernates) in July-September. The ultrairritability of the hibernating generation of *An. martinius* is entirely feasible in biological terms: in the fall, before the cold spells arrive, there may be a redistribution of females among hibernation shelters, and irritability, in combination with tolerance (Table 1), enables them to avoid treated shelters and reliably protect the generation. Physiologically, that ultrairritability is hardly due to obesity, since in the spring, the mosquitoes continue to have a high level of irritability even after they begin blood-sucking.

We feel it likely that there is some population mechanism that operated on the principle of a pendulum and maintains its effectiveness even in the absence of a screening factor (carbamates and DDT). The inheritability of irritability<sup>1</sup> enables the assumption that that mechanism has a genetic basis and consists in fine physiological-biochemical restructurings that take place from generation to generation. The age composition of the population may also be important. Long-term observations are needed to verify those assumptions.

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### Description of Case of Lyme Disease in Eastern Siberia

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[Article by L. P. Ananyeva, A. M. Satyaldyyev, I. A. Skripnikova, I. N. Vasilyev, D. Ye. Karateyev, Institute of Rheumatology, USSR Academy of Medical Sciences, Moscow; UDC 616.993-076.1]

[Text] The study of the spread of Lyme disease in our country began comparatively recently, in the mid-1980's.<sup>2,3,5,6</sup> To date, cases of the disease have been identified in various regions of the USSR (from the Baltics to the Far East), but none has been described in rayons of Siberia through which the western segment of the Baykal-Amur Line [BAM] runs, although a verified case of the disease induced by that borreliosis has been noted in Irkutsk Oblast.<sup>4</sup> This article describes a case of Lyme disease identified on the Buryat segment of BAM in Severobaykalsk.

Here is what we observed:

Patient K. I. A., 56, lives in Severobaykalsk and works as a blacksmith. On 14 July 1988, he was in the woods, and on 15 July 1988, he found on the anterior portion of his left shoulder an embedded tick that was removed when he went to his local clinic, where he was administered immunoglobulin to prevent tickborne encephalitis. On 18 July, he became weak, his temperature rose to 37.5°C, and headaches occurred. Laboratory tests found an elevated CRP (+3), hypogammaglobulinemia (3 percent), acceleration of ESR to 20 mm/hr. The patient was examined in the neurological department in connection with the tick bite in anamnesis, general malaise, the persistent elevated temperature, and an elevation of acute-phase blood proteins in the absence of neurological symptomatology; he was sent to the neurological department of the republic hospital in Ulan-Ude. There, on 27 July, at the site of the tick bite on the left shoulder, a round erythema appeared, increasing to 6-8 cm in diameter, with reddish edges and a light center. The patient was treated with desensitizing agents and symptomatic preparations, and he began to feel better, and 14 days later, the erythema began to diminish, and laboratory values for the inflammatory activity normalized. The patient was released in satisfactory condition with a diagnosis of tick-bite reaction.

Two months after the erythema disappeared, he came down with pronounced pains in the shoulder joints, and then they puffed up a little. He went to his local polyclinic, where he was prescribed antiinflammatory agents, and two weeks after that, the arthritis went away and he was able to return to work. He noted similar swellings of the joints in February and May of 1989, but he didn't see a doctor for them, but just took antiinflammatory agents on his own (analgin, indometacin). In August 1989, he noted arthralgias in the area of those same joints. Those incidents were temporary and went away after he took indometacin. Over the course of the period indicated, two blood tests were done on the patient, and no abnormalities were noted (Hb 80, ESR 11 and 13 mm/hr).

On 1 September 1989, the patient was seen by staff members of the USSR Academy of Medical Sciences Institute of Rheumatology in Severobaykalsk. During the examination, he remarked that he had a little soreness when he moved his joints in the morning and a little soreness of the spine when he did physical labor. No inflammatory changes were found in the peripheral joints or the spine.

Immunological tests of his blood serum taken on 1 September 1989 showed the following: rheumatoid factor (latex test), negative; circulating immune complexes, 3.23 mg/ml (normal, 0.12 mg/ml); SRB [not further expanded] 0.8 mg percent (normal, under 1 mg percent); cryoglobulins absent; immunoglobulins IgG 8.6 mg percent, IgA 2.54 mg percent, IgM 2.2 mg percent; antibodies to *Borrelia burgdorferi* in a titer of 1/80<sup>1</sup>.

Thus, on the basis of the identification of the typical migrating ringlike erythema that developed after the tick embedded itself, the recidivistic joint syndrome chronologically associated with the erythema (which is quite typical of the Lyme-borreliosis), and the presence of antibodies to the agent of that infection, the patient was diagnosed as having Lyme disease.

The case of Lyme-borreliosis described here, in addition to having a typical clinical picture, has clear-cut stages characteristic of spirochetoses. In observation, stage I manifested general toxic symptoms and the tick-induced migrating erythema; stage II, involvement of the joints.

The description of this case of Lyme disease in the BAM area, which is endemic for tickborne encephalitis, supports the notion that the natural foci of those infections are linked, something that requires that doctors be watchful for Lyme disease in regions that serve as a range for tickborne encephalitis and ixodid ticks—its vector.

In light of the fact that the disease is curable in the initial period of the illness, timely diagnosis and proper care are important, since antibiotics of the tetracycline and penicillin series have been shown to be highly effective in therapeutic doses for the prevention of later complications that sometimes develop many months after the tick bite and make treatment much more difficult.<sup>1</sup>

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**Integration of Plasmid-Cloned LysA Gene of *Bacillus Subtilis* Into *B. Subtilis* Chromosome**

937C0131A Moscow GENETIKA in Russian Vol 28 No 6, Jun 92 (manuscript received 03 Jul 91) pp 29-34

[Article by Ye.O. Kalcheva, V.O. Shanskaya and S.S. Malyuta, Institute of Molecular Biology and Genetics, Ukrainian Academy of Sciences, Kiev ; UDC 575.1:576.851.5]

[Abstract] A series of donor and recipient *B. subtilis* strains were utilized in the demonstration that integration of 3 copies of *B. subtilis* lysA gene into the chromosome of *B. subtilis* AT25 results in an 18-fold increase in the synthesis of diaminopimelate decarboxylase (EC4.1.120). However, *B. subtilis* cells with three copies of plasmid pLP1 bearing the LysA gene showed only a 1.6-fold rise in diaminopimelate decarboxylase activity. The results were interpreted to indicate that integration of the LysA gene at the 250° position of the chromosome results in tandem amplification of upstream activating sequences in the cis-position in *B. subtilis* AT25. Figures 1; tables 3; references 24

**Mutagenicity of Water and Silt Samples in Astrakhan Oblast**

937C0131B Moscow GENETIKA in Russian Vol 28 No 6, Jun 92 (manuscript received 28 May 91) pp 62-67

[Article by Z.I. Kurashova, L.G. Dubinina and I.V. Volkova, Institute of General Genetics imeni N.I. Vavilov, Russian Academy of Sciences, Moscow; UDC 575.224]

[Abstract] Environmental monitoring at six sites in the Astrakhan Oblast involved testing of water and silt samples for mutagenicity on *Crepis capillaris* seeds. The results showed that water at the Astrakhan Gas Plant was 2.5-fold as mutagenic as control samples, with the silt even more toxic. Seeds were killed by exposure to the silt for 21 hours, while 2 hours of exposure increased the frequency of mutations 4-fold over the frequency of spontaneous mutations. In addition, mutagenicity of waters from Oblivnoy Island and Upper Buzan River was found to be 1.8- to 2.8-fold greater than control levels, and that of tap water in Astrakhan 1.6-fold higher. Samples from the remaining sites did not appear to pose a health threat, although the findings do indicate that more vigorous measures will have to be taken to mitigate the implied health risk in the oblast. Tables 3; references 9: 8 Russian, 1 Western.

**Genetic Sequelae and Repair of Single-Strand Breaks in DNA of *Arabidopsis Thaliana* in Chernobyl Area**

937C0131C Moscow GENETIKA in Russian Vol 28 No 6, Jun 92 (manuscript received 05 Mar 91; in final form 23 May 91) pp 69-73

[Article by V.I. Abramov, S.A. Sergeyeva, S.N. Ptitsyna, A.B. Semov and V.A. Shevchenko, Institute of General

Genetics imeni N.I. Vavilov, Russian Academy of Sciences, Moscow; UDC 575:585]

[Abstract] An analysis was conducted on the plant DNA repair potential within 30 km of the Chernobyl Nuclear Power Plant using *Arabidopsis thaliana*. Analysis of data for 1986, 1987, 1988 and 1989 revealed a direct correlation between background radiation and the incidence of lethal embryonic mutations and reduction in the capacity for repair of single-strand breaks in DNA. DNA repair efficiency in the *A. thaliana* population was found to diminish from year to year, with a direct correlation with background radiation evident in 1986, 1987, and 1988. Based on studies with other plants, the possibility has been raised that elevated background alpha-radiation may be responsible for the ongoing decline in efficiency of DNA repair in *A. thaliana*. Tables 4; references 9: 7 Russian, 2 Western.

**Genetics of Triticale (X Triticale) Breeding. Part 6. Genetic Basis of Efficient Triticale Breeding**

937C0131D Moscow GENETIKA in Russian Vol 28 No 6, Jun 92 (manuscript received 18 Apr 91; in final form 20 Jun 91) pp 83-90

[Article by I.A. Gordey and G.M. Gordey, Belorussian Scientific Research Institute of Agriculture and Feeds, Minsk Oblast; UDC 633.112.9:631.523]

[Abstract] A review is presented of the genetics underlying over 280 (wheat x rye) hybridization experiments designed to produce novel triticale cultivars. The approaches and strategies were based on efficient use of wheat compatibility with rye, homeologic conjugation of chromosomes, induction of gametes with an unreduced number of chromosomes, and genetic recombinations in wheat and (wheat x rye) hybrids. Pleiotropic effects were evident in  $F_1$  wheat-rye amphihaploids using wheat varieties combining kr and ph genetic systems yielding macro- and micronuclei with diads, triads, and polyads rather than tetrads as a result of anomalous meiosis. The high fertility of the  $F_1$  amphihaploids was due to production of gametes with partially reduced or unreduced chromosome numbers. In addition, disease-resistant and frost-hardy secalotricum were bred by crossing tetraploid rye with hexaploid triticale. Tables 3; references 16: Russian.

**Cloning of 3-Chlorobenzoate Degrading Genes of *Pseudomonas Putida* 87**

937C0131E Moscow GENETIKA in Russian Vol 27 No 10, Oct 91 (manuscript received 19 Feb 91; in final form 12 Apr 91) pp 1697-1704

[Article by A.N. Kulakova, L.A. Kulakov and A.M. Boronin, Institute of Biochemistry and Physiology of Microorganisms, USSR Academy of Sciences, Pushchino, Moscow Oblast; UDC 579.841.11-252.5]

[Abstract] Studies on *Pseudomonas putida* P87, which utilizes 3-chlorobenzoate (cb) as the sole source of

carbon and energy, showed that the  $cb^+$  phenotype was due to plasmid pBS109 which encodes pyrocatechase-II. This plasmid can be transferred by conjugation to *P. aeruginosa* PAO2175 rendering its phenotype  $cb^+$ . pBS109 also has been shown to hybridize with DNA probes bearing  $cb$ -degrading genes of plasmid pAC27. Inefficiency of conjugation and lack of success in eliminating pBS109 from *P. putida* 87 suggest integration with the bacterial chromosome. The latter is also suggested by discovery of  $cb^+$  strains that are plasmid-free after prolonged storage and recultivation. Finally, pBS109 genes specifying  $cb$  degradation have been cloned in a 5.5 kbp segment of plasmid pBS329, and the  $cb^+$  status, but with considerably less efficiency than pBS109. Figures 3; tables 1; references 20: 6 Russian, 14 Western.

**Ecotoxicology and Volga-Caspian Sturgeon: Mutagenicity of Liver Extracts**

937C0131F Moscow GENETIKA in Russian Vol 27 No 10, Oct 91 (manuscript received 27 Jul 90; in final form 12 Mar 91) pp 1754-1758

[Article by Z.I. Kurashova, L.G. Dubinina, I.V. Volkova and M.Ye. Bogdanov, Institute of Evolutionary Morphology and Ecology of Animals imeni A.N. Severtsov, USSR Academy of Sciences, Moscow; UDC 574]

[Abstract] In view of the deepening ecological crisis in the Volga-Caspian basin, a study was made of the mutagenic potential of sturgeon liver as a measure of this specie's exposure to environmental toxicants. The study was predicated on recent observations of a dramatic increase in the number of sturgeons with various abnormalities, including previously unencountered tumors. As a result, aqueous and alcoholic liver extracts were tested for mutagenicity on meristem cells of *Crepis capillaris* roots. The results showed that aqueous extracts of morphologically altered and normal (control) livers were not mutagenic. However, exposure of seeds to alcoholic extracts delayed germination and—when acting on  $G_1$  and S cells—yielded rates of chromosomal abnormalities that were 2.5- to 3-fold higher than control values. These findings demonstrated the presence of mutagens in morphologically-altered hepatic tissues of sturgeons habitating in the Volga-Caspian basin. Tables 2; references 13: Russian.

**Nuclear and Cytoplasmic Factors in Wheat Resistance to Fungal Pathogens: Quantitative Aspects of Resistance to Brown Rust of Alloplasmic Shoots**

937C0131G Moscow GENETIKA in Russian Vol 27 No 10, Oct 91 (manuscript received 18 Sep 90; in final form 29 Dec 90) pp 1781-1789

[Article by Ye.A. Voluyevich and A.A. Buloychik, Institute of Genetics and Cytology, Belorussian SSR Academy of Sciences, Minsk; UDC 575.153:633.11:582.284.22]

[Abstract] Resistance of alloplasmic wheat shoots to brown rust was assessed for a variety of cytoplasm and nucleus combinations to determine the significance of both factors in this form of immunity. The combinations utilized *Aegilops* spp. and *Triticum* spp. as cytoplasm donors and Chinese Spring, Penjamo 62, Leningradka, Neva, and Belorusskaya-12 and -80 wheats as a nucleus source. The results were evaluated on the basis of pustules per  $1\text{ cm}^2$  of leaf surface, spore counts/pustule, and spore count per  $1\text{ cm}^2$  of leaf surface after inoculation of the shoots with uredospores. Dispersion analysis demonstrated that the cytoplasmic factors indicated that certain wild relatives of wheat may be utilized to improve wheat resistance to rust fungi. Tables 8; references 13: 10 Russian, 3 Western.

**Azospirillum (Tarrand, Krieg, Doebereiner, 1979): Genetics of Nitrogen Fixation and Interaction With Plants**

937C0131H Moscow GENETIKA in Russian Vol 28 No 7, Jul 92 (manuscript received 23 Jan 92) pp 5-18

[Article by Ye.I. Katsy, Institute of Biochemistry and Physiology of Plants and Microorganisms, Russian Academy of Sciences, Saratov; UDC 579.252.5:579.841.2]

[Abstract] A literature review is presented of current knowledge on the genetic aspects of nitrogen fixation and *Azospirillum*-plant root interaction. The topics considered included such aspects as cell surface characteristics, phytohormone production and plasmid function. With respect to nitrogen fixation, *nif* genes have been most extensively investigated in *A. brasilense* and *A. lipoferum*, and in the former have been shown to be on six different regions of the chromosome extending over at least 65 kbp. Different *Azospirillum* species have been shown to adhere to different types of gramineous plants, a specificity which is believed to be based on the nature of plant exudates and type of exopolysaccharide formed by the *Azospirillum*. In some cases *Azospirillum* has been shown to penetrate into the roots, and in others to inhibit nodule formation on leguminous plants on combined inoculation with *Rhizobium* spp. Research on phytohormone metabolism in *Azospirillum* has been neglected, but synthesis of IAA has been demonstrated in several species via different pathways. Recent studies have also revealed the presence of four to 400 MD plasmids in *Azospirillum* with copy numbers of six or more, some of which influence chemotaxis, lipopolysaccharide epitopes, nitrate reduction, etc. References 120: 4 Russian, 116 Western.

**Pathogenetic Mechanisms and Prevention of Immunodeficiency in HIV Infections**

937C0131I Moscow GENETIKA in Russian Vol 28 No 7, Jul 92 (manuscript received 05 Dec 91) pp 19-26

[Article by B.D. Brondz, M.B. Zaytseva, A.T. Kozhych, S.A. Moshnikov, O.D. Makarova and Ya.A. Frolova, Oncological Scientific Center, Russian Acad. Med. Sci.;



Institute of Bioorganic Chemistry, imeni M.M. Shemyakin, Russian Acad. Sci., Moscow; UDC 575:599]

[Abstract] Immunodeficiency in HIV infections arises from the fact that, in addition to direct immunosuppressive effects of HIV glycoproteins, antibodies generated against HIV cross-react with class II MHC protein molecules on B cells, as a result of 50 to 70 percent homology between HIV gp120 and gp41 glycoproteins and the  $\alpha$ - and  $\beta$ -chains of HLA-DR molecules on antigen-presenting cells. Consequently, the anti-HIV antibodies react with the appropriate epitopes on the surface of antigen-presenting cells and provide a molecular screen that precludes the reaction of presenting cells with helper cells. Thus, an entire cascade of cellular events is precluded from occurring which normally underlies an immune response. In addition, CD4+ cells are inactivated and depleted as a result of surface formation of trimolecular antibody-CD4-gp120 complexes leading to frank immunodeficiency, in addition to adhesion of these cells to one another mediated by gp120 which also accounts for their depletion. A therapeutic approach to HIV infection is advocated which is based on induction of anti-idiotypic antibodies to neutralize anti-HIV antibodies that react with HLA-DR molecules, thereby precluding their reaction with antigen-presenting cells. Figures 5; tables 1; references 21: 1 Russian, 20 Western.

#### Construction of Novel Vectors for Plant Transformation

937C0131J Moscow GENETIKA in Russian Vol 28 No 7, Jul 92 (manuscript received 97 Aug 91; in final form 21 Feb 92) pp 181-185

[Article by A.L. Lukin, Yu.V. Denisenko, M.M. Sartbayev and V.A. Tarasov, Institute of General Genetics imeni N.I. Vavilov, Russian Acad. Sci., Moscow; UDC 575:11]

[Abstract] Description is provided of the construction of three novel plasmid vectors—pLD-2, pLD-3, and pLD-4—which facilitate cloning genes of higher plants in view of their combinations of restriction sites. The pLD plasmids are derived from pBI-101 and pBI-121 plasmids and contain in the T-region specific antibiotic resistance genes expressible in *E. coli*, in addition to  $\beta$ -glucuronidase and neomycin phosphotransferase-II genes. Detailed assessment of pLD-3 (chloramphenicol<sup>r</sup>) showed successful transformation of *E. coli* JM83, with transfer of the plasmids to *Agrobacterium tumefaciens* (pAL4404) via conjugation. *Arabidopsis thaliana* was transformed with a maximum efficiency of 0.8-0.9 percent by incubation of the seeds with *A. tumefaciens* for 12 hours. Figures 3; tables 1; references 15: 2 Russian, 13 Western.

#### Construction of Linear Plasmid Vectors for Cloning in *Escherichia coli*

937C0131K Moscow GENETIKA in Russian Vol 28 No 7, Jul 92 (manuscript received 06 Feb 92) pp 186-188

[Article by A.A. Vostrov, A.Yu. Malinin, V.N. Rybchin and A.N. Svarchevskiy, St. Petersburg Technical University; UDC 579.25.5:579.842.11]

[Abstract] Details are presented on the use of prophage N15, a 46.3 kbp linear plasmid with covalently closed ends, as a cloning vector in *E. coli*. Transposon mutagenesis was utilized in constructing three 20.2 to 24.5 kbp cloning vectors compatible with replicon colE1- and p15A-based plasmids in *E. coli*. Various fragments of phage  $\lambda$  were cloned in the vectors between the left (gene ori) and right (gene cor) shoulders of N15, indicating that fragment as large as 100 kbp or even larger may be cloned by this method using N15. Figures 1; tables 1; references 5: 2 Russian, 3 Western.

#### Genome Fingerprinting Using PCR With Universal Primers

937C0131L Moscow GENETIKA in Russian Vol 28 No 7, Jul 92 (manuscript received 24 Sep 91) pp 19-28

[Article by S.A. Bulat, O.K. Kobayev, N.V. Mironenko, F.M. Ibatullin, L.A. Luchkina and A.V. Suslov, Leningrad Institute of Nuclear Physics, Russian Acad. Sci., Gatchina, Leningrad Oblast; Scientific Research Institute for Plant Protection, Leningrad-Pushkin; UDC 582.282:575]

[Abstract] Universally primed PCR was assessed for value in fingerprinting the genomes of *Escherichia coli*, *Shigella* spp., *Salmonella* spp., *Yersinia pseudotuberculosis*, *Hafnia alvei*, *Streptococcus pyogenes*, phage lambda, the fungus *Auerobasidium pullulans*, and the pine *Pinus silvestris*. Analysis of eight primers led to identification of 5'-TAAGGGCGGTTGCCAGT as a universal conservative primer providing species-specific patterns for *E. coli*. In addition, two variable primers were identified which allowed differentiation among serotypes within *E. coli*. Further analysis demonstrated that whether a primer is conservative or variable varies with the species under analysis and is unrelated to the nucleotide sequence of the primer. Figures 7; tables 1; references 12: 6 Russian, 6 Western.

#### Specific Human Brain Patterns Based on cDNA Libraries

937C0131M Moscow GENETIKA in Russian Vol 28 No 7, Jul 92 (manuscript received 18 Oct 91) pp 40-46

[Article by O.I. Buyakova, Ye.I. Barinova, L.V. Dergunova, G.L. Khaspekov, I.V. Chivilev and S.A. Limborskaya, Institute of Molecular Biology, Russian Acad. Sci., Moscow; UDC 577:25:612.6(05)]



[Abstract] Poly(A<sup>+</sup>RNA from the frontal cortex, cerebellum, and medulla oblongata obtained three-five hours postmortem were used to construct cDNA libraries in phage  $\lambda$ gt10 vector in order to define regional molecular patterns in the human brain. Differential hybridization using phage plaques on *E. coli* NM514 and subsequent Southern blot analysis resulted in identification of 22 brain-specific clones in the frontal cortex, 7 in the medulla and 0 in the cerebellum, although the ratio of (brain-specific clones + minor clones)/nonspecific clones was essentially identical in each case. Subsequent

Northern blot hybridization using the brain-specific clones as probes for poly(A<sup>+</sup>RNA isolated from various brain formations and other tissues led to isolation of a clone designated Hfb1. Hfb1 was shown to be expressed only in the brain and was found to consist of a 958 bp sequence. The Hfb1 clone does not include extended open reading frames and apparently corresponds to the untranslatable 3'-end of poly(A<sup>+</sup>RNA. Another clone identified in the cerebellum (Hmob3) was also found in skeletal muscles. Figures 3; tables 1; references 15: 3 Russian, 12 Western.

**Problems With Ongoing Monitoring of Information Processing Efficiency***937C0042A Moscow GIGIYENA TRUDA 1**PROFESSIONALNYYE ZABOLEVANIYA in Russian*  
*No 1, Jan 92 (manuscript received 22 Apr 91) pp 12-14*

[Article by A.V. Karpenko, Institute of Occupational Hygiene and Diseases, Kiev; UDC 613.6-092:612.821]-07]

[Abstract] Mental fatigue accounts for ca.  $\frac{2}{3}$  of industrial accidents, and yet current methods of psychometric assessment of fitness for duty are grossly inadequate. Accordingly, ten years of research have led to the design of a PC-based system for ongoing monitoring of information processing ability in the course of shift work. The essential measurements deal with the ability to supply a missing letter or a number in a series. The workers receive immediate feedback and are rated on an individualized performance curve which depicts their mental efficiency at a given time. In conjunction with ergonomic improvements in the industrial sector, a better assessment of information processing efficiency should greatly enhance safety, reliability, and productivity of the labor force. References 12: Russian.

**Neuropeptide Mechanisms in Pathogenesis of Pain Syndrome in Occupational Autonomic/Sensory Polyneuropathy and Mediation of Laser Acupuncture Therapy***937C0042B Moscow GIGIYENA TRUDA 1**PROFESSIONALNYYE ZABOLEVANIYA in Russian*  
*No 1, Jan 92 (manuscript received 20 Jun 91) pp 25-27*

[Article by N.N. Shatskaya, L.M. Komleva and L.A. Tarasova, Institute of Occupational Hygiene and Diseases, USSR Academy of Medical Sciences, Moscow; UDC 616.8-009.7-02:616.833-031.14]- 085.814.1:615.849.1.03]

[Abstract] Blood levels of leu-enkephalin and  $\beta$ -endorphin were monitored in 50 patients with various form of occupational autonomic/sensory neuropathy before and after He-Ne laser acupuncture therapy. Radioimmunoassays showed that the opioid reserves were at the point of depletion in the patients with the more severe pain, implicating them in the pathogenetic process. One course of laser therapy (10-12 sessions) resulted in alleviation of pain and raised opiate levels in 32 percent of the cases. Two courses of therapy provided clinical improvement in 100 percent of the patients in conjunction with a ca. two-fold elevation in leu-enkephalin and  $\beta$ -endorphin. Accordingly, assays of endogenous opioid levels may be used to monitor the severity and progression of sensory neuropathy and efficacy of therapeutic measures. Tables 1; references 15: 10 Russian, 5 Western.

**1-Pyrimidinyl-Piperazine Derivatives: Serotonergic and Dopaminergic Mechanisms of Action**

937C0093A Moscow *EKSPERIMENTALNAYA I KLINICHESKAYA FARMAKOLOGIYA* in Russian Vol 55 No 3, May-Jun 92 (manuscript received 25 Jan 91) pp 8-11

[Article by I.I. Abramets, O.G. Obratsova, I.M. Samoylovich and N.A. Kharin, Chair of Pharmacology, Donetsk Medical Institute; UDC 615.212.3.03:616.001.17-092.9].015.4:616.5-078]

[Abstract] Selected congeners of 1-pyrimidinyl-piperazine were assessed for their effect on isolated spinal ganglia and animal behavior in order to evaluate the importance of dopaminergic mechanisms in tranquilizing activity. The effects of the congeners on membrane polarization of isolated rat lumbar ganglia indicated that they behaved as partial agonists of 1A serotonin receptors. In addition, in conflict trials on outbred white rats, their efficacy as tranquilizers was directly related to their potency as antagonists of D<sub>2</sub> dopamine receptors. In further trials involving immobilization of mice in forced swimming tests potency as dopamine antagonist demonstrated a high degree of correlation ( $r = +0.940$ ) with the duration of immobilization. Accordingly, high tranquilizing activity of the congeners was found to be related to potentiation of serotonergic mechanisms and antagonism of

**Effect of Isonitrosine on Gas Homeostasis**

937C0093B Moscow *EKSPERIMENTALNAYA I KLINICHESKAYA FARMAKOLOGIYA* in Russian Vol 55 No 3, May-Jun 92 (manuscript received 08 Jan 91) pp 30-32

[Article by Yu.N. Maksimov and V.S. Bogdanovich, Laboratory of Pathophysiology, Kiev Scientific Research Institute of Pharmacology and Toxicology, Ukrainian Ministry of Health; UDC 615.217.32.015.4: 616.152.21].076.9]

[Abstract] Isonitrosine, a cholinesterase inhibitor, was tested for its effects on gas homeostasis in a study of its pharmacodynamic spectrum. The results revealed that intramuscular administration of 10 or 20 mg/kg to 10-15 kg outbred dogs enhanced oxygen uptake by 20 and 25 percent, respectively; concomitantly, carbon dioxide elimination was also enhanced. These changes were evident within 15 minutes of administration and persisted for six days. The increase in the respiratory quotient was accompanied by a moderate increase in alveolar ventilation, while the cardiovascular system remained unaffected. Hemoglobin affinity for oxygen was diminished in the isonitrosine-treated animals, although erythrocyte cholinesterase and carbonic anhydrase activities were not affected. These findings suggest that isonitrosine may have therapeutic application as an antihypoxant, particularly in cases of cerebral oxygen deficit. Tables 1; references 17: 16 Russian, 1 Western.

**Selectivity and Therapeutic Efficacy of Muscarinic Antagonists in Dichlorodiviny Phosphate (DCDVP) Poisoning**

937C0093C Moscow *EKSPERIMENTALNAYA I KLINICHESKAYA FARMAKOLOGIYA* in Russian Vol 55 No 3, May-Jun 92 (manuscript received 05 Mar 91) pp 56-58

[Article by A.B. Kosmachev, M.B. Yankhotova and I.M. Kosmacheva, Institute of Toxicology, USSR Ministry of Health, St. Petersburg; UDC 615.217.34.015.23.03: 615.917].07]

[Abstract] In vitro receptor binding studies were combined with in vitro toxicity trials in an assessment of the significance of various subtypes of muscarinic receptors in treatment of DCDVP poisoning. Analysis of the dosages of atropine, Glipin, trihexyphenidyl and Amedine required to counteract DCDVP toxicity and arecoline-elicited tremor indicated that therapeutic efficacy in counteracting poisoning with organophosphorus compounds rests on blockage of M<sub>1</sub> muscarinic receptors. Arecoline-induced tremors were preferentially prevented by agents (atropine, Glipin) binding with higher affinity constants to M<sub>2</sub> receptors, while the more effective agents trihexyphenidyl and Amedine bound preferentially to M<sub>1</sub> receptors. In fact, the greater affinity of atropine and Glipin for the presynaptic M<sub>2</sub> receptors than for the M<sub>1</sub> receptors compromises their efficacy in management of poisoning with organophosphorus agents. Figures 1; tables 1; references 8: 4 Russian, 4 Western.

**Antihypoxic and Radioprotective Properties of Selective Adenosine Agonists**

937C0093D Moscow *EKSPERIMENTALNAYA I KLINICHESKAYA FARMAKOLOGIYA* in Russian Vol 55 No 3, May-Jun 92 (manuscript received 20 Dec 90) pp 72-73

[Article by I.A. Olkhovskiy, V.I. Kulinskiy, A.D. Klimova, M.Yu. Lidak and L.V. Tsalmene, Chairs of Biochemistry, Krasnoyarsk and Irkutsk Medical Institutes; Chemistry Laboratory, KNK [expansion unknown], Latvian Academy of Sciences, Riga; UDC 615.23.015.2: 615.849.1.015.25].015.4.07]

[Abstract] Animal therapeutic trials were performed with selective agonists of A<sub>1</sub> and A<sub>2</sub> adenosine receptors as antihypoxic and radioprotective agents. The studies were performed on female 18-22 g (CBA X C<sub>57</sub>BL) F<sub>1</sub> and C<sub>57</sub>BL mice and 160-200 g male Wistar rats. In the case of hypoxic hypoxia (11,000 m in pressure chamber) subcutaneous pretreatment of the mice with L-N-phenylisopropyladenosine (I; A<sub>1</sub> receptor agonist) or N-ethylcarboxamide adenosine (II; A<sub>2</sub> agonist) increased the survival rate to 25-88 percent from 5 percent control survival in a dose-dependent fashion (0.03-3.9 mg/kg). Similarly, mouse studies also showed that pretreatment with I prolonged the survival time of mice with anemic and histotoxic hypoxias 2- to 3-fold. In x-irradiation

studies both agents increased the survival rate of rats to 60-80 percent from a control value of 4 percent. The therapeutic effects were attributed to a drug-induced 60-75 percent reduction in oxygen consumption and a fall in body temperature of 6-9° C. Assessment of effective doses revealed that II, acting on A<sub>2</sub> receptors, was the more efficacious agent. Tables 3; references 6: 5 Russian, 1 Western.

### **Low-Energy Laser Treatment and Hemocirculatory Dynamics in Anterior Eye Segment in Early Open Angle Glaucoma**

937C0143A Odessa *OFTALMOLOGICHESKIY ZHURNAL* in Russian No 6, Nov-Dec 91 (manuscript received 05 Mar 91) pp 326-329

[Article by A.I. Kolomiyets and V.V. Kurov, Odessa Order of the Red Banner of Labor Scientific Research Institute of Eye Diseases and Tissue Therapy imeni Acad. V.P. Filatov; UDC 617.7-007.681-085.849.19]

[Abstract] An analysis was performed on the outcome of low-intensity ruby laser transcleral treatment (50-70 pulses/session, 0.01-0.1 J; 2-5 sessions at 2-3 day intervals) in early stages of open angle glaucoma. The patients cohort consisted of 37 45-70 year-old patients with a mean intraocular pressure of 32.0 mmHg. The transcleral treatment of the drainage area 1-1.5 mm from the limbus was shown to reduce intraocular pressure to an average of 22.2 mm Hg within a week, an improvement that was evident in a 6 month followup (24.1 mm Hg). In addition, hemocirculatory dynamics in the anterior segment of the eye were also improved as indicated by an increase in arteriolar and venular patency and improved blood flow patterns. Tables 1; references 9: 8 Russian, 1 Western.

### **Biomedical Aspects of Refractive Laser Keratoplasty**

937C0143B Odessa *OFTALMOLOGICHESKIY ZHURNAL* in Russian No 6, Nov-Dec 91 (manuscript received 24 May 91) pp 329-332

[Article by I.M. Kornilovskiy, Moscow Order of the Red Banner of Labor Scientific Research Institute of Eye Diseases imeni Gelmgolts; UDC 617.713-085.849-19]

[Abstract] The full scope of laser sculpturing of the cornea for correction of refractive errors is reviewed from the biological perspective. The factors covered deal with absorptive phenomena which encompass electron-mechanical interactions, photoablation, thermal effects and photochemical reactions in target tissues. Possible late sequelae are also discussed in relation to controlled repair processes and uncontrolled proliferation. However, a main concern that is seldom addressed deals with

potential mutagenic and carcinogenic consequences, particularly when dealing with the less studied modalities such as UV excimers, where secondary fluorescence may pose a special challenge and a unique risk factor. References 21: 11 Russian, 10 Western.

### **YAG Laser-Induced Changes in Ocular Tissues**

937C0143C Odessa *OFTALMOLOGICHESKIY ZHURNAL* in Russian No 6, Nov-Dec 91 (manuscript received 11 Apr 91) pp 347-351

[Article by I.P. Khoroshilova-Maslova, prof., L.D. Andreyeva, senior fellow, and A.V. Stepanov and A.N. Ivanov, cand. med. sci., Moscow Institute of the Red Banner of Labor Scientific Research Institute of Eye Diseases imeni Gelmgolts; UDC 617.7-085.849.19-091.8:612.085.1]

[Abstract] An assessment was made on rabbits on the pathologic sequelae of focused YAG laser irradiation of the lens, vitreous body, and anterior chamber in relation to dose (2.0-7.0 mJ). Follow-up histologic examinations at seven days and two months led to depiction of the destructive changes in the target and adjacent tissues. These lesions encompassed development of cysts in the vitreous body, exudates into the anterior chamber and retinal necrosis and hyperemia, fibrin deposits on the posterior surface of the cornea, etc. The pathologic changes—particularly retinal damage—were dose-dependent and should be given careful consideration when using YAG lasers in ocular therapy. Figures 4; references 14: 1 Russian, 13 Western.

### **Use of Botulin in Ophthalmology**

937C0143D Odessa *OFTALMOLOGICHESKIY ZHURNAL* in Russian No 6, Nov-Dec 91 (manuscript received 14 Dec 90) pp 371-374

[Article by G.D. Zhaboyedov and M.M. Kolesnikov, profs., N.V. Pasechnikova, cand. med. sci., and V.O. Rashchenko, physician, Chairs of Eye Diseases and of Epidemiology, Kiev Medical Institute; UDC 617.758.1-085+615.331]

[Abstract] A review is presented on the application of botulin in ocular therapy in adult, pediatric and neonatal cases. To date, botulin injections have been most frequently used in the management of strabismus without any age-related complications. The usual dosage is on the order of 10E-9 g, giving a wide margin of safety over the lethal human dose of 2 x 10E-6 g. Other conditions in which botulin has been used include nystagmus, blepharospasm, paralysis, and paresis of the VIth nerve, thyroid ophthalmopathy, spastic conditions of eyelids, etc. There have been no reports of systemic complications. However, more extensive utilization of botulin in ophthalmology will depend on improved methods of dosage control and delivery. References 32: 5 Russian, 27 Western.



**Auxin Production by Nitrogen-Fixing Bacteria Associated With Wheat Rhizosphere**

927C0499A Moscow in Russian No 4, Apr 92  
(manuscript received 18 Jul 90) pp 927-931

[Article by L.V. Kravchenko, A.V. Borovkov and Z. Pshikril, All-Union Scientific Research Institute of Agricultural Microbiology, Leningrad; UDC 579.8.017.7-262:633.11]

[Abstract] Several species of nitrogen-fixing bacteria (*Azospirillum brasilense* 200, *Enterobacter aerogenes* 30, *Arthrobacter* sp. 2, *Xanthobacter* sp. 202) associated with the wheat rhizosphere were tested for indoleacetic acid (IAA) production. The results showed extensive variation in the levels of IAA produced, with *Arthrobacter* sp. 2 (72.9 µg/mg dry biomass) and *Azospirillum brasilense* 200 (56.8 µg/mg) giving the highest yields. However, bacterial auxin production was dependent on secretion of L-tryptophan by the plants. Screening studies revealed that only two wheat varieties—Obriy and Mironovka-808—produce this amino acid as an exometabolite. Accordingly, maximum practical benefit in terms of plant growth and development will require pairing of L-tryptophan producing wheat varieties with nitrogen-fixing bacteria capable of IAA production. Figures 2; tables 2; references 11: 2 Russian, 9 Western.

**Natural Selection in Neustonic Bacteria**

927C0499B Kiev MIKROBIOLOGICHESKIY  
ZHURNAL in Russian Vol 53 No 5, Sep-Oct 91  
(manuscript received 26 Oct 90) pp 33-37

[Article by Ye.V. Stabnikova, N.N. Gregirchak, T.O. Taranenko and A.Yu. Nudga, Kiev Technology Institute of the Food Industry; UDC 612.3:576.8]

[Abstract] Hydrophobicity (water:hexadecane partition) was assessed for bacteria isolated from surfaces of bacterial cultures grown on diethylene glycol as the sole source of carbon. Reculturing of *Methylobacterium* sp., *Pseudomonas putida* BS-2, *Alcaligenes paradoxus* BS-1 and larvicidal *Bacillus thuringiensis* var. *israelensis* showed that hydrophobicity of the isolates increased ca. 6.5-fold after seven passages, but the trait was rapidly lost on storage. These observations demonstrated that natural selection operates in neustonic environments favoring predominance of bacteria with hydrophobic surfaces, a factor crucial to surface biofilm formation. Accordingly, selection of bacteria for hydrophobicity has

potential application in formation of larvicidal biofilms and in biological water treatment. Figures 2; references 10: 4 Russian, 6 Western.

**Effect of Cultivation Conditions on Cr(VI) Reduction by Mixed Culture**

927C0499C Kiev MIKROBIOLOGICHESKIY  
ZHURNAL in Russian Vol 53 No 5, Sep-Oct 91  
(manuscript received 20 Jun 90) pp 66-72

[Article by G.S. Yeliseyeva, T.P. Kasatkina and S.L. Kuberskaya, Institute of Microbiology and Virology, Ukrainian SSR Academy of Sciences, Kiev; UDC 579.695:628.35]

[Abstract] Optimization studies were conducted on a mixed bacterial culture—deriving nutrients from crop waste products—suitable for treating Cr(VI)-polluted waters. The culture consisted of cellulose-degrading and butyric acid bacteria isolated from the bovine rumen and Cr-reducing bacteria isolated from industrial waste waters. Efficiency of Cr(VI) reduction was assessed in relation to temperature, active sludge concentration and the physical matrix. The results demonstrated that highest efficiency was obtained on wheat straw and 20 percent activated sludge at 25°C. Cultures utilizing corn stalks formed less efficient systems since they yielded less sugar and, accordingly, required 40 percent active sludge for acceptable levels of Cr(VI) reduction. Tables 6; references 5: Russian.

**Cathodic Protection for Lead Sheathing of Telecommunication Cables Against Sulfate-Reducing and Thionic Bacteria**

927C0499D Kiev MIKROBIOLOGICHESKIY  
ZHURNAL in Russian Vol 53 No 5, Sep-Oct 91  
(manuscript received 19 Jul 90) pp 72-76

[Article by S.B. Yanover, A.I. Lysaya, N.P. Zvyagintseva, Ye.A. Nazarenko, O.A. Lunev and Ye.I. Andreyuk, Institute of Microbiology and Virology, Ukrainian SSR Academy of Sciences, Kiev; Kiev Branch, Institute of Communication; UDC 579.84:620.193:81]

[Abstract] The efficacy of cathodic protection for lead sheathing used for telecommunication cables was assessed in relation to concentration of sulfate-reducing and acidophobic thionic bacteria in Postheist medium B. Cathodic protection was ineffective in preventing corrosion in situations in which the concentration of sulfate-reducing bacteria was  $\geq 10^3$  cells/ml, but was fully protective against equivalent counts of thionic bacteria. These observations demonstrate that special coatings are needed for lead sheathing to ensure adequate corrosion protection against sulfate-reducing bacteria. Figures 4; tables 1; references 5: 3 Russian, 2 Western.

**Biodegradation of Lignocellulose in Cotton Waste by White-Rot Fungi**

937C0045A St. Petersburg MIKOLOGIYA 1  
FITOPATOLOGIYA in Russian Vol 25 No 6, Nov-Dec  
91 (manuscript received 05 Jul 91) pp 469-473

[Article by G.M. Baltayeva and O.N. Malysheva, Botanical Institute imeni V.L. Komarov, Russian Academy of Sciences; Institute of Forest Technology imeni M.S. Kirov, St. Petersburg; UDC 634.0844:582.287.237:636.087.48]

[Abstract] Screening trials were conducted under non-optimum conditions for the selection of fungi selectively removing lignin from lignocellulose of cotton plant stems. Trials with white-rot fungi showed that lignocellulose was most rapidly converted by *Fomes fomentarius*. However, the greatest selectivity in degradation of the lignin component was displayed by *Trametes versicolor*. Consequently, these preliminary studies show that cotton wastes may serve as a potential raw material for feedstuff following microbial treatment for lignin elimination. Figures 2; tables 1; references 11: 7 Russian, 4 Western.

**Search for New Antiparasite Drugs. 6. Synthesis and Study of Acute Toxicity of Haloid Benzamides Containing a Benzophenolic or Diphenyl sulfonic Substituent at Nitrogen**

937C0051C Moscow MEDITSINSKAYA  
PARAZITOLOGIYA I PARAZITARNYYE BOLEZNI  
in Russian No 4, Jul-Aug 91 [manuscript submitted  
17 Sep 90] pp 43-44

[Article by F. S. Mikhaylitsyn, M. N. Lebedeva, N. P. Kozyreva, N. A. Uvarova, N. D. Lychko, S. K. Drusvyatskaya, Institute of Medical Parasitology and Tropical Medicine imeni Ye. I. Martsi novskiy, USSR Ministry of Health, Moscow; UDC 615.284.22:547.582.4].07]

[Abstract] The search for new drugs to treat fascioliasis was prompted by the fact that those now used for treatment have limited efficacy and are somewhat toxic. This report describes the synthesis of 23 benzamide compounds of a general formula, plus the results of a study of acute toxicity. The purpose of the work was to find mildly toxic compounds that could be used for the treatment of fascioliasis. All the substances tested were purified with crystallization, and the data for the elemental analysis corresponded to the theoretically computed values. Toxicity levels were determined with outbred white mice of both sexes (14-18 g). The substances were administered once in a volume of 1 ml per 20 g body weight in a suspension of 2 percent starch cluster. Tolerance was defined as the survival of the animal. The group of haloid-substituted benzamides exhibited a broad range of toxic properties (from 10 g/kg to 0.025 g/kg). Twelve of the 23 compounds were found to have medium or low toxicity and should be tested for their antihelminth properties. Figures 1, references 4: Russian

**Mechanisms of Nootropic Action of Topological Proline-Based Analogs of Piracetam**

937C0069A Moscow  
KHIMIKO-FARMATSEVTICHESKIY ZHURNAL  
in Russian Vol 25 No 6, Jun 91 [manuscript submitted  
28 Aug 90] pp 12-15

[Article by T. A. Gudasheva, N. I. Vasilevich, N. N. Zolotov, V. P. Lezina, S. G. Rozenberg, Ye. V. Kravchenko, R. U. Ostrovskaya, T. A. Voronina, G. G. Rozantsev, A. P. Skold inov, Institute of Pharmacology, USSR Academy of Medical Sciences, Moscow; UDC 615.214.3.015.4.07]

[Abstract] Nootropic compounds have attracted considerable interest in recent years because they specifically activate the higher integrative functions of the brain. Earlier, the researchers here had done work in which they used peptide synthesis to produce a new group of dipeptide analogs of piracetam with an N-terminal pyroglutaminic acid. Later, they expanded the group to include  $\alpha$ -amino acids, with the most marked nootropic effect observed in an amide of

N-acetyl-L-proline (I), which contains all the principal pharmacophoric groups of piracetam and its peptide analogs, similarly positioned in space, but linked through a different system of covalent bonds (hence, a topological analog of piracetam). After Japanese researchers demonstrated that the nootropic activity of certain of the N-acyl derivatives of proline, as well as of pramiracetam and aniracetam, could be linked to their ability to inhibit the prolyl endopeptidase that participates in the inactivation of neuropeptide regulators of memory, the researchers here set out to explain the mechanism of action of the topological proline-based analogs of piracetam. They found a structural specificity of nootropic action among the N-acyl derivatives of the L-proline amide, a specificity that is dependent on the size and nature of the substituent in nitrogen pyrrolidine. Increasing the size leads to either the disappearance or the return of the nootropic activity. PNR demonstrated the presence of two conformers topologically identical to piracetam. Figures 2, references 12: 9 Russian, 2 Western, 1 Japanese.

**Benzimidazolylalkyl Sulfonic Acid: Synthesis and Antiviral Activity**

937C0069C Moscow  
KHIMIKO-FARMATSEVTICHESKIY ZHURNAL  
in Russian Vol 25 No 6, Jun 91 [manuscript submitted  
27 Dec 89] pp 33-35

[Article by Yu. V. Badeyev, O. K. Pozdeyev, V. B. Ivanov, V. D. Korobkova, S. V. Andreyev, Ye. A. Yegorova, E. S. Batyyeva, Institute of Organic and Physical Chemistry imeni A. Ye. Arbuzov, Kazan Affiliate, USSR Academy of Sciences; UDC 615.281.8:547.436].012.1]

[Abstract] Influenza and other acute respiratory diseases caused by RNA-containing viruses are among the leading viral infections in terms of incidence and scale of epidemic process. Various vaccines have long been used as specific prophylactics of the flu, but they are not very effective, because of the antigen variability of the virus during the epidemic process. That led the researchers here to investigate the use of chemotherapeutic agents against influenza infections. An in vitro analysis of the antiviral activity of benzimidazolylalkyl sulfonic acids found them to have virtually no effect on the reproduction of the virus associated with A/Leningrad 34/72 (H3N2) in a culture of chick embryo cells. The researchers performed in vivo studies on outbred white mice infected with an A/Aichi 2/68 (H3N2) influenza virus adapted to lung tissue. They found toxicity to vary within a range of 500-1150 mg/kg, with five of the six compounds tested showing a protective effect. The protection indices for the active compounds ranged from 35.8 percent to 48.8 percent. The compounds lengthened the lives of the experimental animals by 0.7-15 percent. The researchers concluded that the compounds may be capable of affecting the functional activity of factors of nonspecific resistance to infection, with enhancement

and acceleration of the immune response to the infectious agent. That led them to study the effect of one of the derivatives on the development of the primary humoral immune response to ram erythrocytes. It was found that the administration of the compound produced a 2.3-fold increase in the number of antibody-forming cells. References 5: 3 Russian, 2 Western.

### Synthesis and Radioprotective Properties of Derivatives of Oxolinic Acid

937C0069D Moscow

*KHIMIKO-FARMATSEVTICHESKIY ZHURNAL*  
in Russian Vol 25 No 6, Jun 91 [manuscript submitted  
9 Jan 89] pp 42-44

[Article by N. V. Kotelnikova, T. S. Leonova, I. V. Ankudinov, V. V. Znamenskiy, V. G. Yashunskiy, Institute of Biophysics, USSR Ministry of Health, Moscow; UDC 577.391.621.386.86]

[Abstract] As an extension of previous work by the researchers in which they demonstrated that oxolinic acid provides a marked radioprotective effect in laboratory animals injected intraperitoneally with an aqueous suspension, the researchers studied the effect of a modification of the carboxyl function that changes dramatically the hydrophilic nature of the molecule on radioprotective activity. Via the interaction of a chloranhydride and 2-dialkylaminoethanolamines and 2-dialkylaminoethylamines, they synthesized a 2-dimethylaminoethyl ether, a 2-morpholinoethyl ether, and a 2-piperidinoethyl ether of 1-ethyl-4-oxo-6,7-methylenedihydroxy-1,4-dihydroxynolin-3-carboxylic acid, plus a 2-diethylaminoethylamide and a 2-piperidinoethylamid of the acid. They were extracted in the form of water-soluble chlorhydrates. The toxicity of the compounds were studied in outbred white mice; the antiviral activity, in male (CBAxS57V1)F<sub>1</sub> mice. Most of the compounds evidenced average toxicity. The radioprotective activity of the dialkylaminoethyl ethers and the amides was on a par with that of the initial compound. The researchers concluded that the degree of hydrophobicity of the compounds is not a determining factor in the manifestation of the radioprotective effect. Figures 1, references 4: 2 Russian, 2 Western.

### Ubiquinones and 35-Methoxyhop-6-en-32,33,34-Triol From Methylophilic Acetobacteria

937C0069E Moscow

*KHIMIKO-FARMATSEVTICHESKIY ZHURNAL*  
in Russian Vol 25 No 6, Jun 91 [manuscript submitted  
27 Apr 90] pp 83-85

[Article by L. M. Kogan, I. V. Kozlova, T. M. Filippova, Ye. A. Obolnikova, G. T. Orekh, S. V. Skryabina, Yu. Ye. Kazantsev, NPO Vitaminy, All-Union Scientific Research Institute of Protein Synthesis, Moscow; UDC 615.356:577.161.6/012.6:579.841.92:579.222]

[Abstract] In a search for microorganisms that contain ubiquinone-10, the researchers examined two strains of acetobacteria. In light of the fact that acidophilic bacteria contain that compound, they used chromatography to isolate it from acetone extract of the biomass of the methylophilic *Acetobacter* sp. VSB 917 and *A. methanolicus* IMET V-10945. A substance isolated from the polar fraction of lipids of *Acetobacter* sp. VSB 917 was shown to be 35-methyl ether of hop-6-en-32,33,34,35-tetraol. Figures 2, references 14: 2 Russian, 12 Western.

### Synthesis and Biological Activities of Phosphonium Derivatives of Aza-Crown Ethers

937C0121A Moscow

*KHIMIKO-FARMATSEVTICHESKIY ZHURNAL*  
in Russian No 12, Dec 91 (manuscript received  
19 Feb 91) pp 17-19

[Article by G.I. Vankin, N.V. Lukoyanov, A.A. Chaykovskaya, T.N. Kudrya, L.M. Pacheva, T.G. Galenko, T.A. Ivanova, O.A. Rayevskiy, V.V. Malygin and A.M. Panchuk, Institute of Physiologically Active Substances, USSR Acad. Sci. Chernogolovka, Moscow Oblast; Institute of Organic Chemistry, Ukr.SSR Acad. Sci., Kiev; UDC 615.216.5:547.898].012.1.07]

[Abstract] Search for novel myorelaxants led to the synthesis of a series of aza-crown ethers, commencing with derivation of aza-15-crown-5 and diaza-18-crown-6 ethers. In vivo and in vitro studies demonstrated that all of the following 8 phosphonium products possessed curare-like properties: N,N'-bis(dichloroamidophosphite)-diaza-18-crown-6, N,N'-bis(tetramethyldiamidophosphite)-diaza-18-crown-6, N,N'-bis(tetramethyldiamidomethylphosphonite-iodide)-diaza-18-crown-6, N,N'-bis(dimethylamidofluoromethylphosphonite-iodide)-diaza-18-crown-6, N,N'-bis(dimethylamidofluorophosphonite-fluoride)-diaza-18-crown-6, N-dichloroamidophosphite-aza-15-crown-5, N-tetramethyldiamidophosphite-aza-15-crown-5, and N-(tetramethyldiamidomethylphosphonite-iodide)-aza-15-crown-5. Accordingly, the phosphonium derivatives of aza-crown ethers have been shown to represent a new class of neuromuscular blocking agents. Figures 1; tables 2; references 2: 1 Russian, 1 Western.



**Reactivity and Interaction of Rat Cortical Neurons to Microionophoretic Application of Acetylcholine in Negative Learning Model**

937C0077A Moscow ZHURNAL VYSSHEY NERVENNOY DEYATEL'NOSTI IMENI I.P. PAVLOVA in Russian Vol 42 No 2, Jul-Aug 92 (manuscript received 27 May 91; in final form 12 Nov 91) pp 720-727

[Article by Yu.L. Martinson and A.A. Myasnikov, Institute of Higher Nervous Activity and Neurophysiology, Russian Academy of Sciences, Moscow; Chair of Higher Nervous Activity, Moscow State University; UDC 612.822.3+612.825+615.78]

[Abstract] Recordings were obtained and spectrally analyzed from 46 neuron pairs in the sensorimotor cortex (layers IV-V) of 180-250 g male albino rats before and after 20-80 ionophoretic applications of acetylcholine

for 0.05 sec. Discharge pattern analysis showed that acetylcholine stimulated 26 percent of the neurons, exerted an inhibitory/excitatory effect on 41.3 percent, an excitatory/inhibitory effect on 14.1 percent, and an inhibitory/excitatory/inhibitory effect on 8.7 percent. A few neurons responded with inhibitory (2.2 percent) and excitatory/excitatory (2.2 percent) changes. These responses were equally characteristics of high-amplitude/low frequency and low-amplitude/high frequency neurons. In 29 pairs (63 percent) the responses to acetylcholine were identical and in that category 55.2 percent of the responses were of the inhibitory/excitatory type and 24.1 percent excitatory. In the remaining pairs each cell responded differently. Cross-correlation measurements indicated relative stability of excitatory connections between neurons and possible facilitation of inhibitory connections when one of the paired cells exhibited habituation to acetylcholine. Figures 2; tables 1; references 9: 5 Russian, 4 Western.

### Population Exposure Radiation and Dose Regulations and Medical Consequences of the Chernobyl Accident

937C0057A Moscow MEDITSINSKAYA RADIOLOGIYA in Russian No 12, Dec 91 [manuscript submitted 25 Apr 91] pp 9-18

[Article by L. A. Ilin, delivered as a paper at a combined international conference under the aegis of the Soviet and French societies for nuclear engineering, held 15-17 April 1991; UDC 614.876(477)-07]

[Text] *1. Theory and practice of regulations regarding radiation exposure for people in the Chernobyl accident.*

Long before the accident at the No. 4 unit of the Chernobyl AES, my colleagues and I developed criteria for the making of decisions to protect the population in the event of an accident involving a nuclear reactor.<sup>6,7,11,20</sup> Those criteria served as the basic principles of radiation protection in official USSR Ministry of Health documents published in 1971 ["Temporary Procedural Instructions for the Development of Measures To Protect the Populace in the Event of a Reactor Accident, Approved by the Deputy Chief Health Physician of the USSR 18 Dec 1970", Moscow, 1971. Preprint publication] and then in a second, revised edition (1982) ["Criteria for Making Decisions Involving the Taking of Measures To Protect the Populace in the Event of Reactor Accidents, Approved by the chief state health physician of the USSR 5 Nov 82" (see also L. A. Ilin, G. M. Avetisov, MED. RADIOL., 1983, No 5, p 92.<sup>6</sup>). Our previous publications<sup>8,24,25</sup> have presented an analysis of the importance of the use of those criteria in the early stages of an accident at Chernobyl and, above all, for the decisions to evacuate the population.

The enormous scale of the spread of the radioactive emissions released by the destroyed unit No. 4 at Chernobyl, to which hundreds of thousands and even millions of people were exposed, resulted in the need to develop a whole array of fundamentally new determinations and regulations, as well as a number of derivative intervention levels for which there was, when the accident happened, no experience anywhere in the world.

We are talking here about the fact that the accident at Chernobyl defined—not on a theoretical basis, but in fact—the reality of the existence of three phases in an accident and, consequently, the need for differentiated, but interrelated approaches to establishing the intervention level and regulations at various stages of a post-accident situation.

The radiobiological basis of the regulations and levels of intervention in the various phases of the accident was based on two principles: (1) the nonallowance (prevention) for nonstochastic effects in the early period; (2) the minimization of possible stochastic (long-term) effects of irradiation.<sup>8,24</sup>

That in turn signalled the need for effecting strict regulations with regard to the irradiation of people, regulations that were aimed at not exceeding the dose limits established by the USSR Ministry of Health.

Let us examine step by step the logic of the events in the context of that section of the work.

a. We recall that in correspondence with the "Criteria..."<sup>11,20,24,25</sup> two levels of exposure were adopted: level A—the predicted dose of whole-body gamma irradiation not to exceed 0.25 Gy or 0.25-0.3 Gy for the thyroid gland of children as a result of incorporation of radionuclides of iodine; level B—not to exceed 0.75 Gy and 2.5 Gy, respectively. According to the "Criteria..." in the interval between A and B, measures were to be taken, with the possible disruption of the life of the populace, including evacuation. If the B level of exposure were exceeded, emergency evacuation of the population would be indicated. As for the accident at Chernobyl, as a result of the evacuation of the residents of Prip'yat and the rest of the population from the 30-km zone around the Chernobyl AES, the precise levels of whole-body irradiation of the residents of that city at the moment of evacuation (45,000 people) turned out to be in the not-excessive range of 30-40 mSv, with maximum average levels of 120-130 mSv. Because the rest of the populace living within 30-km radius of the AES was evacuated later (as late as 5 May 1986), the doses of whole-body gamma irradiation in a number of population centers (Tolstiy Les and Kopachi), according to estimates, were as high as 0.3-0.4 Gy.<sup>8,25</sup> Thus, in that situation, the level of the maximum whole-body irradiation was not exceeded.

b. After the completion of the evacuation of the people of Prip'yat (27 Apr 1986) and of the nearby population centers, hundreds of thousands of people remained in the radioactively contaminated areas, the size of which was constantly being clarified. That required the introduction of an allowable regulation (limit) of whole-body irradiation for those contingents of the populace. That level for the limit of irradiation for the entire first year after the accident was adopted by the USSR Ministry of Health as 0.1 Gy. [That maximum level of whole-body irradiation for one year has been defined earlier (1979) as a limit of accidental irradiation of the populace.<sup>16</sup>] Officially, that figure was less than the level of criterion A—0.25 Gy—by a factor of 2.5, and according to the criterion, with whole-body irradiation over a short interval of time after the accident at a nuclear reactor, no protective measures disrupting the lives of the populace were required.<sup>11,20</sup> Nevertheless, in the radiobiological interpretation of the numerical values of that limit (0.1 Gy), the attenuating role of the time factor in the realization of the biological action of such irradiation should be kept in mind.

c. In the early stages of the accident, when the primary danger to the populace as a factor of provocation of nonstochastic effects of irradiation was the whole-body external gamma irradiation, as well as the inhalational

route of entry of radioactive iodine into the body, the most realistic and adequate approach in the decision-making involving the protection of the hundreds of thousands of people was the regulation of irradiation in terms of gamma-irradiation dose rate. The introduction of such a derivative intervention level was a new approach into the system of regulations involving irradiation of the populace as a result of the scale of the accident at Chernobyl. Such a method of regulation produced real possibilities for solving questions regarding whether people should be allowed to live in a specific area, and, conversely, it determined the need for emergency evacuation or the introduction of special protective measures.

In addition, the "Criteria..." were almost not applied for making decisions on the basis of on-line assessment of doses of irradiation of the thyroid glands of children, because of the immense territorial scale of the accident and the absence of the necessary equipment and trained personnel who could have provided qualified examination of the people in the various regions of the country. After the first decisions were made regarding the evacuation of the people of Pripjat and then the people within the 30-km radius of the AES, the next stage involved a decision on the zoning of the areas around the station and outside those areas in terms of the proper isolines of gamma-irradiation dose rate. Not dwelling on details, we note that the following were taken into consideration in the assessments of the expected average absorbed doses of external irradiation: the critical (in terms of dose size) groups of the populace (forest workers, machinery operators, etc.), the length of time spent outside and inside by rural and urban residents, the differences in the factors

of attenuation of gamma irradiation by rural structures ( $K_0 = 2$ ) and urban structures ( $K_0 = 10$ ), etc. Ultimately, the following total coefficients of protection were used: 0.46 for the rural population, 0.24 for the urban population.

d. The followings zones of radioactive contamination were established:

(1) Zone of permanent evacuation—the area bounded by the isodose line with the smallest value for gamma-irradiation dose rate at "D+15" mR/hr (0.2 mGy/hr). Inside that area, irradiation doses exceed the yearly dose limit (0.1 Gy), and the radiation situation there is not expected to be normalized in the years to come.

(2) Zone of temporary evacuation—the area located between the isodose lines of 20-5 mR/hr at D+15; it is possible that the populace will return to that area as the situation normalizes.

(3) Zone of monitoring—the area was defined as being between the isodose lines of 5-2 mR/hr at D+15. The populace was not evacuated from that area. Exceptions were children and pregnant women, who, in an organized fashion, were taken to "clean" regions of the country for a summer health-related vacation of up to 2-3 months. Regular dosimetric monitoring of the environment, food products, water and fodder is done in that area.

The expected exposition and absorbed doses of gamma radiation at the boundaries of the zones established as a result of the accident at Chernobyl are presented for the early and intermediate phases of the accident in Table 1.

Table 1. Probable Exposition and Absorbed Doses of Gamma Radiation at the Boundaries of the Delineated Zones

Day [24-hr period] after accident	Radiation dose rate, percentage of R at D+15*	Exposition doses of gamma radiation at R at D+15, in R			
		1 mR/hr	2 mR/hr	5 mR/hr	20 mR/hr
1	5.30	0.30	0.60	1.50	6.0
2	3.86	0.41	0.82	2.05	8.2
4	2.40	0.55	1.10	2.75	11.1
7	1.65	.70	1.40	3.50	14.0
15	1.00	0.94	1.88	4.70	18.8
30	0.54	1.20	2.40	6.00	24.0
90	0.21	1.66	3.22	8.30	32.0
365	0.07	2.38	4.76	11.80	47.6
Total exposition dose of gamma radiation in cloud and fallout, in R	—	2.62	5.34	13.00	52.36
Expected absorbed doses of gamma radiation, in cGy:					
Urban population	—	0.60	1.30	3.10	13.00
Rural population	—	1.20	2.40	6.00	24.00

\* D+15 = day 15 after accident

The figures presented in Table 1 for the expected absorbed doses confirm the validity of the limits of access and living conditions determined for each zone. It follows from Table 1 that outside the 20 mR/hr isoline for dose rate, as a result of the gamma radiation alone, the predicted irradiation, especially of the rural population, exceeded the regulation for the yearly dose of whole-body irradiation several times over. In the zone of temporary evacuation, the prediction of absorbed doses was in the range of 0.06-0.24 Gy. Consequently, the exceeding of the established limit was entirely feasible from the gamma radiation alone.

From that, it follows that the decision to temporarily evacuate the people from that area should be recognized as having been the right decision. For the zone of monitoring, the irradiation of the rural population should not exceed the level of 0.06 Gy. In addition, a strict system of dosimetric monitoring has been instituted there, and the consumption of locally produced food products has been restricted. Assessments made (by M. N. Savkin) showed that taking the children and pregnant women away for a summer health-related vacation lowered the expected doses by 30-45 percent.

The next stage of activity involving the regulations for irradiation of the populace was to ascertain the yearly limits of whole-body irradiation for the populace living in the regions that were contaminated with radioactivity. The level of 100 mSv (external and internal irradiation) established for the first year after the accident, primarily because of the instituted measures, was ensured, and the actual level of irradiation was almost one-third the established standard. Later, the NCRP for subsequent years (to 1989) made the standard stricter every year. For example, for 1987, the maximum level of 30 mSv was introduced, whereas the level of 25 mSv was introduced for 1988 and for 1989. On the whole (over a period of 44 months after the accident), the total was 173 mSv.<sup>8</sup>

The introduction of the those levels of intervention into the first two stages after the accident and of strict protective measures was justified by the need for solving the main problem—the prevention of high levels of irradiation of the populace. In addition, those measures could not help but have an effect on the abrupt disruption of the traditional tenor of life of the populace. In the late (recovery) period, in addition to providing radiation safety at an acceptable level, the chief problem was to be the return of the populace to the normal, pre-accident living conditions. Living a lengthy period of time in an area contaminated with radionuclides under restricted conditions (a ban was introduced on producing and consuming food products of local origin) could lead not only to negative socioeconomic and emotional consequences, but also to the direct loss of health among the populace as a result of poorer nutrition in the broad sense of that word and to somatic effects associated with the press of psychogenic factors. It was those very aftereffects that we encountered. It is not without cause that the

MAGATE [not further expanded] document "Safety Series No. 81" places special emphasis on this: "...the making of decisions related to dose levels (and consequently, also to derivative levels) that weaken or change protective measures must obviously take into account broader sociopolitical concepts." In connection with the circumstances noted earlier, the main principles of regulation should have been based on optimization approaches in the establishment of dose limits whose introduction would have predetermined the removal of all restrictions in the daily activities of the populace. Unfortunately, for a number of reasons that had had nothing to do with us, the pros and cons in that situation in the USSR were not weighed. A study of the radiation-hygiene situation in thousands of population centers that are scattered over broad areas and present a highly varied mosaic (lack of uniformity) in terms of radionuclide fallout had to ensure their unique radiological "certification." The principal stage of that work was completed in late 1987-early 1988, and the question arose about the strategy after that in the establishment of regulations pertaining to the irradiation of the populace.

The NCRP produced a proposal to set the intervention level beginning 1 January 1990 in the form of an allowable limit of whole-body exposure over a lifetime.<sup>1,8</sup> Where that limit was not reached (in accordance with the prediction), all restrictions for the normal daily activities of the populace were removed; where the limit was exceeded, however, it was recommended that the populace be resettled elsewhere, beginning in 1990. It was also obvious in regions in which the intervention level was not reached, the ALARA [not further expanded] principle was to be implemented.

Based on radiation medicine experience, the NCRP recommended a lifetime dose of 350 mSv, which included the whole-body irradiation dose received by the populace before 1 January 1990. The lifetime dose limit (350 mSv) was very conservative. First, adopted as the criterion of intervention is the expected dose for a critical group of the population, and not the average individual dose for residents of a given population center. Second, the duration of living in a specific population center is taken to be 70 years, i.e., according to that factor, "critical" individuals are those who were born in the years around the accident (1986 $\pm$ 2). Third, in terms of external gamma irradiation, the criticalness of a group is determined by the features of the occupational activity of individual categories of the adult population (field workers, foresters) whose levels of irradiation are 1.3-1.7 times higher than those of other population groups. Fourth, in terms of internal irradiation, the level of criticalness is based on an analysis of the probability of the ingestion of radionuclides with one's daily food intake, and used as an indicator of its contamination levels is the level of cesium radionuclides in milk. In light of the fact that the distribution of the probabilities of the



levels of contamination of milk is markedly logarithmic, the critical value for the ingestion of radionuclides was set at the 90 percentile of that distribution, which is 1.7 times higher than the weighted mean. Fifth, adult characteristics are used in the model for calculating doses of internal irradiation among the child population. Finally, sixth, the half-life for radioactive cesium in the soil/grass/milk chain is taken to be 14 years.

Taken together, all those assumptions result in at least a twofold reserve in the numerical value of the expected dose over 70 years. It follows from that that in the final analysis, we are talking about a realistically predicted expected individual dose of irradiation of 100-170 mSv over an individual's lifetime. The logic of the NCRP recommendations for setting the intervention level at 350 mSv, and not at the true expected levels mentioned above was based on the requirements for sensible caution and "overinsurance" in relation to a whole array of uncertainties of a scientific, as well as organizational nature.

How do the intervention levels adopted and proposed by the NCRP compare with the international recommendations? According to the data of some researchers,<sup>15</sup> in the early phase of the accident, the criterion for solving the question about the evacuation was the range of values of the predicted "short-term" dose of whole-body irradiation of 50-500 and 500-5000 mSv for any individual organ (including the thyroid gland). That range of whole-body irradiation is extended to the intermediate phase, in the part affecting the criteria for the resettlement of the populace. In that document, the late phase is not examined. According to the data of another publication,<sup>30</sup> for the early phase a limit was established at 500 mSv as a prevented dose of whole-body radiation and at a dose of 300-500 mSv for the long term (months to years). A comparison of the dose-related intervention levels used here in the early stages of the accident and those recommended by international organizations show them to be almost identical. In addition, with regard to the regulations for irradiation of the populace in the so-called late period, the recommended intervention levels and their continual interpretation have substantial difference with the NCRP approach. In actuality, from a strictly radiological standpoint that has a purpose of predicting expected stochastic consequences of irradiation, the recommendations of some researchers<sup>30</sup> do not take into account the irradiation dose already accumulated by the populace when the decisions are made. The numerical values for the maximum dose-related intervention levels (the decision-making criteria) are expressed in units of prevented dose (300-500 mSv), i.e., a dose at which the irradiation of people declines as a result of a given measure of protection or some combination of measures. Thus, essentially, the maximum level of irradiation established by the NCRP on the basis of the

above coefficients of reserve is substantially lower than those proposed in the document for the upper intervention levels.<sup>30</sup>

The concept proposed by NCRP in 1988 served as the point of departure for planning and effecting the resettlement of people from population centers in which the expected dose of whole-body irradiation of 350 mSv, according to the prediction, might be exceeded.<sup>8</sup> In accordance with the decree of the USSR Government on emergency measures to eliminate the aftereffects of the accident at Chernobyl AES, people must be resettled from certain rayons in 1991-1992. [That decree, at the recommendation of local authorities, included additional intervention levels for resettling people in the form of values for density of radioactive contamination of an area with <sup>137</sup> (above 40 Ci/km<sup>2</sup>) and, in particular, for resettling children under 14 and pregnant women (above 15 Ci/km<sup>2</sup>).]

As we know, the NCRP concept caused considerable discussion and criticism from, mainly, individual political leaders, certain domestic organizations, and republic academies of science. The primary focus of the criticism was the intervention level of 350 mSv, which is regarded as unacceptably high. Finally, as early as 1991, the government formulated and approved a new "Concept for Remaining in Rayons Afflicted by the Chernobyl AES Accident," the essence of which amounts to the following [the NCRP did not take part in developing this concept]. On all territories radioactively contaminated, a minimal intervention level is set at 1 mSv, the average annual individual effective equivalent dose of irradiation. The upper limit is 5 mSv for 1991. In the indicated interval of annual dose rates, protective measures are taken, and residents have the right to voluntarily resettle out of those zones.

Without dwelling on an analysis of scientific prerequisites and the social-psychological consequences proceeding from the realization of that concept, we should recall the fundamental tenet in the area of radiation protection of the populace<sup>15</sup>: "In practice, no measure should be introduced if the risk of further irradiation is less than the risk that will accompany the execution of that measure." Unfortunately, no one performed any quantitative analysis of the benefits and harm stemming from the broad actions planned in this case.

It is of interest to adapt the intervention levels adopted in this concept to actual scales of expected resettlement of people. Table 2 presents the calculated number of residents and the number of population centers in which the average individual dose of external and internal radiation in 1991 will exceed 1 and 5 mSv (I. I. Linge). This version of assessment assumed that the entire population (705,500) lives in 2,056 population centers located in the area bounded by the isoline delineating soil contaminated with radioactive cesium at 5 Ci/sq km.

**Table 2. Calculated Estimates of Size of Population and Number of Population Centers in Which in 1991 the Expected Average Individual Doses of External and Internal Radiation Will Be Higher Than 1 and 5 mSv**

Dose range, mSv	Conditions					
	Internal irradiation no more than 0.3 mSv		Internal irradiation of no more than 0.5 mSv		Unlimited internal irradiation	
	Population, in thousands	Number of population centers	Population, in thousands	Number of population centers	Population, in thousands	Number of population centers
≥1	312.4	1,148	399.7	1,533	470.0	1,698
1-5	306.4	1,108	393.0	1,485	415.3	1,418
<5	6.0	40	6.7	48	54.7	280

From an analysis of the data presented in Table 2, it follows that in the given range of intervention levels—1-5 mSv—some 400,000 people will be added (in voluntary resettlement) to the earlier recommended systematic resettlement of residents with a predicted lifetime dose of 350 mSv (50,000-60,000 people).

Experience in the resettlements that have already taken place with regard to the people in the zone of monitoring has shown that because of the marked lack of uniformity (the mosaic nature) of radioactive contamination, people in nearby population centers are also resettled, because otherwise the infrastructure of the rayon, collective farm, etc., is disrupted. For that reason, in this case one can introduce an additional coefficient of 2 with confidence. As a result, we are actually talking about the resettlement of about 800,000 people.

It also follows from Table 2 that in 1991, against the backdrop of present constraints, a level of whole-body irradiation above 5 mSv will be exceeded in a total of 12,700 people living in 98 population centers (not including 42,000 people in population centers in which the predicted lifetime dose exceeds 350 mSv).

And so, in the new concept, the introduction of a lower intervention level (1 mSv/yr) reflects a desire to move to the pre-accident norms without any regard for the realities attending the Chernobyl accident. It should be recalled at this point that the system recommended by the MKRZ for limiting dose "is used for irradiation produced by controlled radiation sources in normal conditions of work." That is why the system of dose limits, which includes the average annual level of irradiation of 1 mSv/yr recommended by the MKRZ for the populace, is not applicable to the irradiation of the populace as a result of the accident. With the accident, the source of radiation is not under control, and irradiation of individuals in the population can be limited (although not always) merely by certain activity that disrupt one's normal lifestyle. Such activity is termed "intervention," and its main component is the "application of the proper protective measures for limiting the irradiation of people."<sup>20</sup>

*II. Levels of irradiation among the populace* The last two or three years have seen the continuation of large-scale operations involving the study and assessment of the radiation-health situation in the afflicted regions. That research has made it possible to refine the dose loads on the populace, which were first summarized in a paper given at the session of the general assembly of the USSR Academy of Medical Sciences that took place on 21-23 March 1989.<sup>8</sup> That so-called baseline prediction has been revised twice (in March 1990, from the results of studies done in 1989, and at present, on the basis of data collected in 1990).

What facts and circumstances were addressed in the refinement of the levels of whole-body irradiation among the populace?

1. Corrections were introduced into the general assessments of collective dose for lower levels of whole-body irradiation of the population living in large population centers (more than 5,000 people). For example, it was shown that in terms of external irradiation, the expected dose (in cSv) for the period 1991-2006 corresponds to a coefficient of  $0.29 \sigma_{137}$  (where  $\sigma_{137}$  is the density of contamination of the soil by  $^{137}\text{Cs}$ ) in small population centers and  $0.15 \sigma_{137}$  in large centers. Afterwards, as a result of the analysis of data from measurements *in vivo*, it was shown that with the characteristics of  $^{137}\text{Cs}$  density being equal, the average individual dose of internal irradiation in large population centers is half that in small centers.

2. A corrected coefficient for the dependence of  $^{137}\text{Cs}$  concentration in potatoes on the density of that radionuclide in the soil was produced. With it, the calculated expected individual dose corresponds to  $D_{\text{internal}} = 0.03 \sigma_{137}$ .

3. Over a two-year period—from 1988 through 1990—the by-volume activity of  $^{137}\text{Cs}$  in milk declined 3.2- to 2.2-fold (Gomel and Mogilev oblasts), which turned out to be higher than prediction estimates based on the initially adopted period of half-life of that nuclide in the grains-milk chain of 14 years.

4. Finally, the actual doses of internal irradiation in 1990 came against the backdrop of the continuing action of time-related allowable levels (concentrations) of radionuclides in food products (VDU-88).

The levels of individuals doses of whole-body irradiation of the populace living in the areas under strict monitoring were estimated by adding the doses of external  $\gamma$ -irradiation and internal irradiation resulting from the ingestion of cesium and strontium via the alimentary canal. For external  $\gamma$ -irradiation, three groups of assessments were used: (a) maximum expected annual dose in a population center; (b) expected annual dose for various occupational and age groups in a given population center; (c) individual annual dose retrieved from data of individual dosimetric monitoring. The sample of individuals in whom direct measurements were made in 1988 and 1989 consisted of roughly 6-7 percent of the total population. Analysis of 2,500 test results by a group from the Institute of Biophysics of the USSR Ministry of Health in 1987-1989 for 32 population centers showed that the distribution of individual doses has a rather universal face, which can be approximated with a log-normal dependence.

In a summary of all those results, statistical distributions were calculated for individual doses of external irradiation for 1986-1990 for every population center, and then they were totaled into a general distribution of individual doses for the entire zone of monitoring. Those assessments did not take into consideration the migration of the population for that period, birth rate, or death rate. It was determined that the average individual dose of external irradiation for the areas under strict monitoring was 2.67 cSv, and the collective dose was  $7.28 \times 10^3$  man-Sv (Table 3).

**Table 3. Structure and Levels of Doses of Irradiation Among the Populace of Areas Under Strict Monitoring Over the Period 1986-1989**

Irradiation	Dose	
	Average individual equivalent, cSv	Collective, man-Sv- $10^3$
External	2.67	7.28
Internal	0.86	2.34
Total	3.53	9.62

Internal irradiation was also assessed with three techniques: (a) from known values of density of contamination of farmlands and coefficients of transfer of  $^{137}\text{Cs}$  along the primary biological chains, based on the typical diet of the residents and a model of a typical individual;

(b) from results of radiology assessments of food products based on diet; (c) from data of direct measurements of  $^{134,137}\text{Cs}$  in the body, based on individual anthropometric and age indices.

The results of the assessments in the context of (a) and (b) were maximum expected doses of internal irradiation, since they did not consider the possibility of replacing in every specific case the part of the contaminated diet with "clean," trucked-in food. In actuality, the introduced system of restrictions on the consumption of contaminated food products deformed the distribution of expected internal doses substantially. For example, for 90 percent of the population centers, actual average doses determined with the SICh [not further expanded] device turned out to be lower than the calculated values by 2.5 to 25-fold. The average values of that ratio was equal to 9.6, and the medial of distribution was 7. Ultimately, the following assessments of levels of internal irradiation via incorporation of radioactive cesium in the bodies of residents of the areas under strict monitoring for 1986-1990 were produced: average individual dose of 0.82 cSv and collective dose of  $2.23 \times 10^3$  man-Sv. It was also shown that the contribution of the equivalent dose of  $^{90}\text{Sr}$  to the total dose of irradiation for 1986-1990 does not exceed 5 percent. Table 3 presents data on the structure and levels of individual and collective doses of irradiation among the populace of those areas. After comparing the results presented in Table 3, one can conclude that the contribution of internal irradiation to the average individual equivalent dose of irradiation among the populace of the areas under strict monitoring is on the order of 25 percent. It should be kept in mind that the correlations of individual doses of external and internal irradiation can differ substantially from that average value among the various population centers, as well as within them, for many reasons. Table 4 presents the distribution of the levels of average individual equivalent doses of irradiation of the population who lived in population centers under strict monitoring from 26 April 1986 through 1 January 1990. It follows from Table 4 that the average individual effective equivalent dose (EED) for that period was 3.5 cSv, and the collective dose was  $9.6 \times 10^3$  Sv. According to the data of M. N. Savkin, the average EED for occupational groups in the populace that are critical in terms of irradiation levels—farm and forest workers—is around 6 cSv. The group of people whose irradiation could have exceeded 17.3 cSv (total of annual accident limits of doses for 1986-1989) was under 0.5 percent.

**Table 4. Distribution of Levels of Doses of Irradiation Among the Population That Lived in Population Centers Under Strict Monitoring From 26 April 1986 Through 1 January 1990**

Range of individual doses, cSv	Baseline prediction			Refined calculation 1990		
	Resident population, in thousands	Number of residents with indicated dose, in percent	Collective dose before 1990, in thousands man-Sv	Resident population, in thousands	Number of residents with indicated dose, in percent	Collective dose before 1990, in thousands man-Sv
0.5-1.0				18.6	6.8	0.14
1.0-2.0	16.4	6.0	0.24	69.3	25.4	1.04
2.0-3.0	13.5	5.0	0.35	63.9	23.4	1.60
3.0-4.0	105.7	39.0	3.88	42.6	15.6	1.49
4.0-5.0	33.7	12.0	1.56	25.3	9.3	1.14
5.0-6.0	31.0	11.4	1.67	15.6	5.7	0.86
6.0-7.0	24.9	9.1	1.62	11.5	4.2	0.75
7.0-8.0	6.8	2.5	0.51	8.2	3.0	0.62
8.0-10.0	29.0	10.6	2.49	9.0	3.3	0.81
10.0-12.5	6.0	2.0	0.67	4.9	1.8	0.55
12.5-15.0	2.4	1.2	0.32	1.8	0.7	0.24
15.0-17.3	2.6	0.9	0.41	1.0	0.4	0.16
17.3	0.8	0.3	0.18	1.1	0.4	0.2
Total	272.8	100	13.9	272.8	100	9.6

So the average individual dose of whole-body irradiation, according to the refined estimates, turns out to be roughly one-third less than the baseline prediction of 1988 and 1989 (3.5 and 5.1 cSv, respectively, over the period of 1986-1989). As has already been noted, the baseline population living in the areas under strict monitoring in that period was taken to be invariable. The refined collective dose, by comparison with the baseline prediction ( $13.9 \times 10^3$  man-Sv), was  $9.6 \times 10^3$  man-Sv.

A comparison of the data presented in Table 4 indicates a change in the structure of the distribution of doses toward lower values, as well as an increase in the populace exposed to lower levels of irradiation. It is enough to point out that roughly 220,000 individuals were exposed in the range of individual doses of 0.5-5 cSv, which made up 80 percent of the total population

living in those areas (from a baseline prediction of only 62 percent). Finally, the data presented in Table 4 enable the conclusion that by comparison with the established limit of whole-body irradiation of the population over the given period (average total individual dose of 17.3 cSv), the actual dose was at least one-fifth that. That, in turn, is evidence of the effective role of the complex of measures in the field of radiation protection of the population adopted in that period.

Of interest is the analysis of the refined values for the expected collective doses (1986-2056) for the populace living in the areas under strict monitoring, when the lifetime dose limit of 350 mSv is introduced (and the 1 January 90 restrictions are removed to return the people to normal living conditions) and the expected doses are introduced without any regulation of their limits (Fig. 5).

**Table 5. Refined Prediction of Expected Collective Doses of Whole-Body Irradiation Among the Populace That Lived in the Areas Under Strict Monitoring\* of Five Oblasts in Russia, Ukraine, and Belorussia (in man-Sv- $10^3$ )**

Oblast	Lifetime dose limit 350 mSv		No restrictions on lifetime dose	
	Baseline prediction	Refined prediction in 1990	Baseline prediction	Refined prediction in 1990
Zhitomir	7.7	1.9	9.3	2.6
Kiev	4.2	2.6	7.2	2.8
Gomel	17.6	8.0	21.1	9.4
Mogilev	4.8	2.5	7.9	3.8
Bryansk	19.7	8.7	27.1	12.4
Total	54	23.7	72.6	31.0

\*The areas under strict monitoring in the various rayons constitute different percentages of the area and population of the administrative rayons. On average, for the five oblasts, 35 percent of the total population of a rayon live in those monitored areas.



From Table 5 it follows that the 1990 correction of the expected collective doses leads to a substantial decline in their numerical values—on average, by more than two-fold.

Table 6 presents similar estimates for nine oblasts of the three republics exposed to the most radioactive contamination.

**Table 6. Refined Values for the Expected Collective Doses in Nine Oblasts of Russia, Ukraine, and Belorussia (in man-Sv-10<sup>3</sup>)**

Republic, oblast	Population, in thousands	Baseline prediction	1990 Refined prediction
<b>Ukraine:</b>			
Zhitomir*	1547	26	18
Kiev*	4446	47	41
Chernigov	1428	9	
Total	7421	82	68
<b>Belorussia:</b>			
Gomel*	1678	67	52
Mogilev*	1282	18	14
Total	2960	85	67
<b>Russia:</b>			
Bryansk*	1472	50	36
Tula	1865	13	
Orel	864	2	
Kaluga	1035	6	
Total	5236	71	57
Grand total	15,617	238	192

As can be seen in tables 5 and 6, the expected collective dose is on the order of  $192 \times 10^3$  man-Sv. The fact that

the figure is 20 percent lower than the baseline prediction is explained primarily by the correction of the collective dose for areas under strict monitoring (see Table 5).

Internal irradiation of the human thyroid gland as a result of the incorporation of iodine radionuclides is known to be an extremely important radiological problem stemming from the accident at Chernobyl.<sup>8</sup>

Numerous circumstances that, in most cases, have no connection with the scientific aspects of the problem were the source of immense, often insurmountable difficulties both in the acquisition of the necessary primary dosimetric information and in the implementation of the programs of retrospective retrieval of individual doses. Nevertheless, over the course of the last two years intensive work has continued that has enabled the refinement of dose loads and the substantial expansion of the volume of assessments and the base of data.<sup>3</sup> The first preliminary summaries of the problem (baseline estimates) were presented in a report made by Ilin et al.<sup>8</sup> That report gave new refined data for Belorussia and Russia on the status through March 1991 [for Belorussia, the data were from Yu. I. Gavrilin, V. T. Khrushch, S. I. Shinkarev, et al.; for Russia, from M. I. Balonov, I. A. Zvonova, Yu. O. Konstantinov, and V. F. Stepanenko]. With regard to Belorussia, materials were presented that were differentiated for the populace living in the rural areas and in urban-type settlements.

Tables 7 and 8 present data on the average individual and collective doses of irradiation of the thyroid gland for the entire population (466,600 in Belorussia and 705,000 in Russia) and children under 7 living in the areas that received the most contamination. The population of children under 7 was taken to be 10 percent of the total population. The departure point for the estimates presented, particularly for Belorussia, were results of measures and retrieved individual doses of irradiation of the thyroid gland in 68,000 people.

**Table 7. Levels of Irradiation of the Thyroid Gland Among the Populations of Belorussia and Russia in the Areas That Received the Greatest Amount of Radioactive Contamination (1991 estimate)**

Republic	Oblast	Number of rayons	Population, in thousands	Average dose, cGy	Collective dose, in thousands man-Gy
<b>Belorussia</b>					
Rural population	Gomel	9	238.6	41.0	98.0
	Mogilev	5	93.7	18.5	17.0
	Total	14	332.3	34.6	115.0
Urban-type settlement population	Gomel	9	85.6	17.8	15.0
	Mogilev	5	48.7	7.8	4.0
	Total	14	134.3	14.1	19.0
Entire population		14	466.6	28.7	134.0

**Table 7. Levels of Irradiation of the Thyroid Gland Among the Populations of Belorussia and Russia in the Areas That Received the Greatest Amount of Radioactive Contamination (1991 estimate) (Continued)**

Republic	Oblast	Number of rayons	Population, in thousands	Average dose, cGy	Collective dose, in thousands man-Gy
<i>RSFSR</i>					
Entire population	Bryansk	6	286	13	37.0
	Tula	5	210	13.8	29.0
	Orel	2	44	7.2	3.2
	Kaluga	7	171	13.5	23.0
	Total	20	705	12.9	92.2
	Grand total	34	1171.6	19.2	226.2

**Table 8. Levels of Irradiation of the Thyroid Gland Among Children Under 7 in Belorussia and Russia in the Areas That Received the Greatest Amount of Radioactive Contamination (1991 estimate)**

Republic	Oblast	Number of rayons	Population, in thousands	Average dose, cGy	Collective dose, in thousands man-Gy
<i>Belorussia</i>					
Rural children	Gomel	9	23.9	106.0	25.0
	Mogilev	5	9.3	43.9	4.1
	Total	14	33.2	87.7	29.1
Urban-type settlement children	Gomel	9	8.6	44.2	3.8
	Mogilev	5	4.9	21.5	1.1
	Total	14	13.5	36.3	4.9
All children under 7		14	46.7	73	34.0
<i>RSFSR</i>					
All children under 7	Bryansk	6	29.8	37	11.0
	Tula	5	22.4	40	9.0
	Orel	2	4.7	21	1.0
	Kaluga	7	17.5	43	7.5
	Total	20	74.4	38	28.5
	Grand total	34	121.1	51.6	62.5

It follows from Table 7 that the collective dose of irradiation of the thyroid gland among the entire population of Belorussia and Russia living in the regions with the greatest amount of contamination (including the areas under strict monitoring) was 226,000 man-Gy for a population of 1,170,000 individuals, including 134,000 man-Gy for Belorussia and 92,000 man-Gy for Russia. In that population, the dose loads on the child population 7 or under at the moment of the accident had reached 62,500 man-Gy (see Table 8).

By comparison with the baseline prediction,<sup>8</sup> the refined estimates lead to a 1.3-fold-higher estimate of the

average individual doses for the category of "entire population" and to a negligible decline for the child population. The collective doses for the entire population were 2.3- to 1.3-fold higher. In the analysis of the data, one must keep in mind that by comparison with the baseline prediction, the estimates for Belorussia included a large population (466,000 people versus 291,000, and 46,700 children under 7 versus 31,000).

In the worst-hit areas of Belorussia, roughly half of the children under 7 received dose loads on the thyroid gland exceeding 30 cGy, with the level of irradiation of that organ exceeding 200 cGy in almost 8 percent of the children (Table 9).

Table 9. Distribution of Levels of Irradiation of the Thyroid Gland in Children Under 7 (1991 estimate)

Dose intervals, cGy	9 rayons of Gomel Oblast (32,420 people)		5 rayons in Mogilev Oblast (14,240 people)		14 rayons of Gomel and Mogilev oblasts (46,660 people)	
	Abs.	%	Abs.	%	Abs.	%
0-30	15,128	46.660	9637	67.68	24,765	53.080
30-75	8951	27.610	2975	20.88	11,926	25.550
75-200	4924	15.190	1345	9.45	6269	13.440
200-500	2428	7.490	251	1.76	2679	5.740
500-1000	693	2.140	28	0.20	721	1.550
1000-2000	274	0.850	4	0.03	278	0.600
2000-3000	20	0.060	0	0	20	0.040
3000-4000	2	0.006	0	0	2	0.004

Work was begun in the USSR in 1986 in the diagnosis, prevention, and treatment of possible thyroid pathology in connection with the Chernobyl accident. The extent and quality of that research are constantly growing and improving. At present, that program is being carried out in a number of scientific and practical medical centers of Russia, Belorussia, and Ukraine [preliminary results of the research in the form of individual papers from the republics were reported at a special symposium on the effects of irradiation of the thyroid gland, which took place under the aegis of WHO (Chernigov, UkSSR, 3-6 December 1990).

### III. Health problem

The health status of the populace that was exposed to radioactive releases continues to be a very acute problem. It should be noted that even five years after the tragedy, physicians and radiologists in the USSR continue to have sharp words about the issue. In this report, we are interested in, of course, pathology whose link to exposure to radiation is well known.

Here, briefly, are some of the summary data of the research results reported 12-14 March 1991, in Minsk, at the republic conference "Scientific-Practical Aspects of the Preservation of the Health of the People Exposed to Radiation As a Result of the Chernobyl Accident." Kazakov et al.<sup>10</sup> reported in the areas contaminated with radiation in the Gomel and Mogilev oblasts, no deviations were found in the dynamics of the overall mortality rate as compared with the pre-accident period, and the indicators for child and perinatal mortality and stillbirth rate are in the range of the perennial trend. The overall oncology morbidity in the monitored areas is also, by and large, within the range of the perennial trend; no change was detected in the structure of that morbidity. No growth in morbidity associated with acute leukemias among children was found in the epidemiological analysis.<sup>9</sup> As of 1 June 1990, the republic dispensary of the Institute of Radiation Medicine (Minsk) had examined 29,550 individuals (including 17,162 babies) living in the areas under strict monitoring in the above oblasts. Their health status in 1989-1990 was compared with a

baseline of 1985. The researchers<sup>12</sup> concluded that the health indicators for the population were essentially unchanged both in Gomel Oblast and in Mogilev Oblast, as compared with the pre-accident period. Also studied were the dynamics of the rate of birth of children with congenital developmental defects of strict followup from the monitoring system.<sup>13</sup> It was established that overall in the monitored areas, the frequency of such defects over the three years after the accident had consistently grown. In addition, a similar pattern was noted in Belorussia as a whole. The researchers attempted to compare the acquired data with the levels of irradiation dose among the population examined. In the absence of a proper correlation, the researchers concluded that the consistent growth in the frequency of that pathology could be due to a complex of adverse environmental factors, and it is not yet possible to identify the percentage of that complex represented by radiation exposure.

In an analysis of 5,126 histories of births to women in Ukraine who have been exposed to radiation in the early phase of the accident or in the following period, deviations were identified in adaptation-compensation mechanisms of hormonal metabolism of the fetal-placental system.<sup>19</sup> In 14,500 pregnant women and newborns, the functional status of the thyroid system was studied. It was established that in 1986 and into 1987, the levels of TTH and thyroxine tended to rise both in pregnant women and in newborns, but that the levels normalized by the middle of 1987. The researchers concluded that there were no appreciable changes in the endocrine system in either group, but that both groups living in areas contaminated with radionuclides should be carefully watched and should undergo follow-up observation for the status of the thyroid and internal systems. An in-depth general clinical and neurological study was made of children living in areas under strict monitoring in Belorussia who have been born in September-December 1986 and January-February 1987.<sup>19</sup> Among 342 children, no cases were recorded of microencephaly, Downs syndrome, or CNS defects, and the changes in the main anthropometric indicators, including head size and times for the reduction and closing of the fonticuli, were normal for age. According to population research data for Belorussia,<sup>4</sup> no children were identified with clinical

signs of hypothyroidism, and all the children examined with hormonal tests were in a state of laboratory euthyroidism. However, by comparison with control, there was a consistent decline in the content of triiodothyronine and thyroxine, with higher levels of TTH. Children exposed to radioactive iodine at an early age (under 3) or in later years (4-6 years of age) require the most medical care.<sup>4,9,14</sup>

In late 1990 and early 1991, there were indications of a sharp rise in thyroid cancer morbidity among children in Belorussia and Ukraine.

It is being reported, in particular, that, according to the data of the Belorussian Republic Center for the Treatment of Tumors of the Thyroid Gland, from 1986 into 1990 a total of 42 children were recorded as having the disease and underwent surgery for that, with 30 of those cases identified in 1990 alone.<sup>2</sup> Despite the fact that no documented scientific data has been presented yet on that subject, the indication that malignant tumors of that organ began appearing 2-3 years after the accident merits serious attention and thorough study. In fact, the reports do not correlate with worldwide experience<sup>21-23,27-29,31</sup> concerning the minimal latent period of radiation-induced malignant tumors. In an ultrasound study of the mass and structure of the thyroid gland of 8,355 children and adolescents in Kaluga Oblast [the control group in this oblast consisted of 2,882 individuals], where the thyroid dose loads in a number of cases reached 10 Gy, no differences were identified in the sonographic pictures of the children of both groups.<sup>18</sup> Nor was there established a link between absorbed dose and structural changes in the organ. No malignancy was identified in the cytological tests of the aspirate of the thyroid of any of 38 children. Those data are in agreement with the results of tests performed by independent international experts working in 1990 in the three republics that were affected by the accident. According to the conclusions of the experts, lumps of the thyroid gland were observed very rarely in children and were identified in 15 percent of the adults examined in monitored population centers and radionuclide-contaminated population centers. Malignant degeneration of the thyroid tissue was not found in a single case among the children and adults examined.

In conclusion, it should be emphasized that the levels of irradiation of the thyroid in children and adults make it possible to assert that the induction of malignant tumors of that organ is entirely feasible. That circumstance has served as the basis for effecting broad-scale observations for the timely identification and treatment of that pathology. Primary attention in this complex program should be focused on a representative methodology of research and objective verification of data of diagnostic tests and clinical observations.

#### Conclusions

1. Information has been systematized on a complex of problems involving the development of a regulation

strategy and intervention levels in the USSR for the purpose of protecting the population against the radiation resulting from the accident at Chernobyl.

2. Presented are updated data (as of 1991) on the levels of whole-body irradiation among the population of areas under strict monitoring, plus dose loads on the thyroid of children and adults.

3. Several aspects of the health status of the population in terms of pathology of radiation etiology have been examined.

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**Experimental Infection Induced by Issyk-Kul Arbovirus**

937C0051A Moscow MEDITSINSKAYA

PARAZITOLOGIYA I PARAZITARNYYE BOLEZNI

in Russian No 4, Jul-Aug 91 [manuscript submitted 9 Jul 90] pp 15-16

[Article by D. K. Lvov, I. I. Terskikh, L. N. Abramova, N. S. Savosina, T. M. Skvortsova, V. L. Gromashevskiy, Institute of Virology imeni D. I. Ivanovskiy, USSR Academy of Medical Sciences; UDC 616.98:578.833.1/.2]-092.9]

[Abstract] Certain biological properties of the LEIV K-315 strain of the Issyk-Kul virus, isolated from bats, was studied in experimentally infected white mice, hamsters, and green monkeys. The virus was judged to be fairly stable in the environment. Its infectious activity remained at a high level after being kept for 24 hours at 24°C, although the titer in mouse brain dropped by 2.75

log LD<sub>50</sub>/0.03 ml. After being heated to 56°C and kept there for 10 minutes, the titer dropped dramatically, but infectious properties remained even after 90 minutes. The titer reached 1.75 log LD<sub>50</sub>/0.03 ml. At pH 7.2, the infectious activity remained even stronger. White mice infected with the virus via the brain died after six days. Histological studies showed meningoencephalitis. Soft tissue was edemous and abundantly infiltrated. Focal interstitial pneumonia developed in the lungs, and hepatitis in the liver. Nephritis was identified in the kidneys, and the spleen was infected. Subcutaneous infection resulted in death after seven days. Death in both cases of infection was from CNS involvement and inflammatory-dystrophic changes in the internal organs. The infection did not bring death in the hamsters, but they were sacrificed after 14 days. Examination showed meningoencephalitis. The infection proceeded in a virtually symptomless manner in the green monkeys, but after sacrifice, autopsy showed all organs to have been affected. References 8: 6 Russian, 2 Western.

### System for Chromatographic Data Capture by IBM PC/XT/AT Systems

937C0041A Tbilisi SOOBShCHENIYA AKADEMII  
NAUK GRUZII in Russian Vol 142, No 3, Jun 91  
(manuscript received 07 Jun 91) pp 581-583

[Article by K.D. Amirkhanashvili and Ye.M. Glazyrin, Institute of Organic and Physical Chemistry imeni P.G. Melikishvili, Georgian Academy of Sciences; UDC 543.544]

[Abstract] A new approach is presented for capture of chromatographic data by IBM PC/XT/AT computers as developed at the institute, using software written in Turbo Pascal. The key features consist of an analog-to-digital converter, a 580II55 interface and CHROM 2.0 and TEST programs for data processing and recording in computer files. The system carries a five year guarantee. Figures 2; references 4: 3 Russian, 1 Western.

### Soyuzmedinform's Medical Information System

937C0139A Moscow VESTNIK ROSSIYSKOY  
AKADEMII MEDITSINSKIKH NAUK in Russian No  
6, Jun 92 (manuscript received 13 Nov 91) pp 53-57

[Article by A. A. Kiselev and B. L. Loginov, Soyuzmedinform Scientific Production Association, Moscow, under the rubric "Medical Informatics and Computer Engineering": New Automated Information Technology"; UDC 61:0026:681.3]

[Text]

#### 1. Introduction

An automated system of scientific medical information (OASNMI) has been on line in the health care system for more than 15 years. In 1985, the second line of this system was put in operation, but the actual indicators of its operation remained low (total database consisted of 25,000 entries; about 100 constant specialized inquiries were not functional in the remote access mode, and the process of preparing bibliographies was not automated).

The main reason for this situation was, in our opinion, administrative, scientific and economic separation of the main information elements of the sector: All-Union

Scientific Research Institute of Medical and Medicotechnical Information (VNIIMI), State Central Scientific Medical Library (GTsNMB) and the Printing Combine (PK). Suffice it to state that the VNIIMI and GTsNMB used different data retrieval languages to form databases and library catalogues.

In 1988, the Soyuzmedinform NPO [scientific production association] was formed in order to improve dramatically this sector's information service, and it included the VNIIMI, GTsNMB and PK.

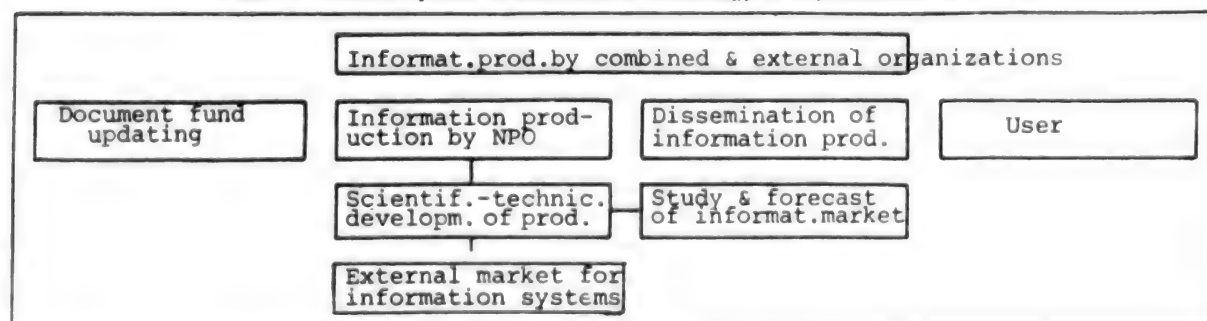
The GTsNMB is one of the largest libraries in our country, with 2.2 million volumes. Up to 1000 readers are serviced and 4500 documents handed out at the GTsNMB each day. A total of 1.7 million copies and 11 million pages from periodicals on microfiches enter into the network. The GTsNMB is involved in centralized collection of complete medical libraries of foreign periodicals, and purchase about 2000 different periodicals.

For better screening of foreign books and efficient use of hard currency allocations, the Soyuzmedinform organizes permanent exhibits of foreign books, at which it makes its own purchases and serves as an intermediary for other consumers of medical literature. In addition, the GTsNMB is engaged in extensive exchange of books and periodicals with more than 1000 foreign organizations in 80 countries. Virtually all Soviet medical books, collections of institute and conference proceedings are automatically delivered to the GTsNMB, and some of them become part of the exchange fund to update the libraries of our country and developing countries. The GTsNMB performs the function of republic-level medical library of the RSFSR.

#### 2. General System of Soyuzmedinform Information Technology

Soyuzmedinform is an All-Union specialized center of medical information and is a structural department of the USSR Ministry of Health. All three organizations of the scientific production association (VNIIMI, GTsNMB and PK) use the same technology, which is illustrated in Chart 1.

Chart 1. General system of information technology of Soyuzmedinform NPO



Within the limits of this technology Soyuzmedinform has the following duties:

- Keeping the stock of documents of the GTsNMB up to date and complete.
- Generation of bibliographic and factographic databases pertaining to medicine and public health.
- Publication of informative literature (medical abstract journal, surveys and current information on various branches of medicine and health care, bibliographies, the joint Soviet-American periodical, MEDICAL MARKET, and others).
- Production of audio-visual information.
- Furnishing information on the basis of traditional library services, dissemination of information publications, as well as use of domestic and foreign databases in off-line and on-line modes.
- Investigation of need for biomedical information.

Sociological research in the field of medicine and health care.

- Development and introduction of new computerized technologies for information.

We shall discuss here in greater detail the automated technology of producing and using bibliographic databases pertaining to Soviet medical literature.

### 3. Integrated Technology for Generation and Use of Soviet Biomedical Database

In 1988, a new computer system was developed by Soyuzmedinform and adopted by the GTsNMB, which made it possible to develop, for the first time in the USSR, a complete database on Soviet medical literature and to provide broader information services on its basis.

Development of the technology was based on the following guidelines: to provide a complete base of data on Soviet medical literature; integration of library, publishing and information processes within Soyuzmedinform (internal integration); integration with external Soviet and foreign information systems in the biomedical field (external integration principle).

The principle of internal integration signifies unification of the process of creating an electronic catalogue of the GTsNMB with the process of publishing bibliographies and information services for GTsNMB readers.

External integration signifies the transition to the most popular system in the world of indexing documents (MeSH), translation of tables of contents into English, providing access to the database both within the USSR and abroad.

The technology was constructed on the basis of the fact that it must provide for achieving the following:

1. Generation of computer base for Soviet medical literature totaling 85,000-100,000 documents, 60,000-80,000 with tables of contents translated into English. The database includes the following documents: 3600 Soviet books, 150 medical periodicals, 25,000 articles from periodicals, 45,000 articles from collections of institute works and conference proceedings, 6700 dissertations, 4500 unpublished materials (filed manuscripts, standard-setting and methodological material, translations), 10,000 information documents about research, 500 descriptions of algorithms and programs for automation of medicine and health care. This constitutes about 95 percent of all Soviet medical literature.

2. Preparation of bibliographic cards for the catalogue totaling 100,000 titles printed in 1000 copies.

3. Publication of 52 issues of a weekly current index of the database in Russian and English in 1000 copies.

4. Publication of 10 topical indexes with 12 issues per year.

5. Taking care of up to 5000 inquiries in the mode of selective distribution of information (IRI).

6. Taking care of at least 1500 inquiries on the basis of using Soviet and foreign databases in on-line mode.

7. Copying database for the network of libraries and other information centers.

8. Provision of two-week period for processing documents before input in database.

9. Furnishing copies of original sources on the basis of search in the base and current index.

10. Translation of documents into foreign languages upon request of foreign database users.

In addition, the system provides for in-depth indexing and a low percentage of spelling errors.

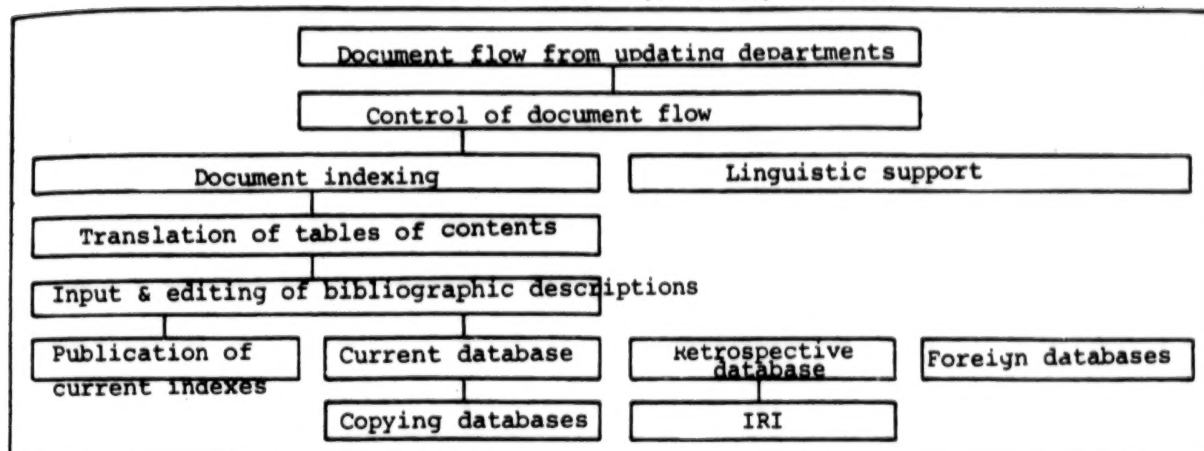
Let us examine Chart 2 and the problems that had to be solved in the course of developing it.

At the first stage, all of the first copies of documents are delivered to the department of document flow control, where the books and articles are recorded, marked and coded. Coding consists of assigning a library storage code and the marking—of indicating whether the document must be included in the database for a domestic or foreign user. In addition, this is where uniform batches of documents are formed for input of data into the base.

Then the marked documents are forwarded for indexing. Since 1990, Soviet medical literature is indexed using the MeSH thesaurus of the U.S. National Medical Library, which includes additional descriptors that are necessary to reflect the specifics of Soviet medical terminology.



Chart 2. Chart of automated system of Soyuzmedinform



It must be noted that up to now Soviet medical literature had been indexed using the subject list of GTsNMB. In spite of all the difficulties involved in reorganizing catalogue management in the network of numerous medical libraries and retraining consumers, we consider the switch to the new linguistics to be essential for international standardization of the retrieval system. The main problem encountered by GTsNMB as the generator of the database was to create its own system of managing a bilingual thesaurus, which is necessary, not only for ongoing addition of new descriptors into the complex multihierarchic structure of MeSH, but also for continuous refinement of Russian equivalents of American terminology. For this purpose, a package of applied programs in the DBASE III+ language was developed, which performs the following functions: development of current version of MeSH including a check of terms and relations; addition of national part to the thesaurus; development of a relational database for bilingual thesaurus; check for consistency of input information and editing of descriptor article; preparation of computer versions of the main dictionaries and relations of thesaurus in any language; automatic formation and print-out of different forms of thesaurus display (hierarchical, alphabetic, permutation and other indicators in any of the input languages); random search for terms in bilingual thesaurus.

In addition, the computer base of the bilingual thesaurus is used for automatic replacement of Russian terms with English equivalents when transmitting the bibliographic base to foreign users. At the present time, an automated workplace for a linguist is being developed, which would improve considerably the quality and productivity of indexing.

After indexing, article and book titles and contents are translated into English. By the end of the current year, development of the first version of a system for automated translation of titles from Russian into English will be completed.

After indexing and translation, the documents go to the input and editing department. Input and editing are effected by means of the automated operator-bibliographer workplace, which permits execution of the following operations in the menu mode: selection of input format for all types of documents on the monographic and analytical levels; automatic formation of GOST-specified bibliographic description of all types of documents on standard-size bibliography cards on screen and paper; editorial corrections of document descriptions.

Input of documents in the database requires a high level of organization of the monitoring service, which prepares the schedules for operator work, distributes the literature, verifies and records the works. This is executed by means of an automated monitoring workplace.

After input of the documents, the information is printed out in the form of bibliographic cards, of which copies are made for the network of medical libraries. Concurrently, the current database to service readers and the automated editorial system for current bibliographic indexes are loaded. Once a month, information is loaded into the retrospective database for retrieval in the remote access mode. The retrospective base has been installed at the VNIIPAS [All-Union Scientific Research Institute of Automated System Planning?] situated in Moscow, and at the German Institute of Medical Information and Documentation (DIMDI) in Cologne, FRG.

The current database contains information for the past 3 months and is used on a PC-386 IBM with 160 megabyte disk memory in a program environment, including the Micro CDS/ISIS information retrieval system and additional software which, in addition to retrieval, permits execution of the following operations: automated preparation of Gost-specified bibliographic cards; automated request for copies of original sources with output of a standard order blank both according to base-search results and without prior search; automated formation of

current and cumulative bibliographic indexes; operation of database in response to specialized inquiries (IRI mode) and their automatic execution; automatic transliteration of Cyrillic into Latin alphabet; conversion of data from ISO-2709 to textual format and the reverse; automated management of bilingual multihierarchic thesaurus to form retrieval instructions.

Concurrently with updating the current base, the automated system of operational preparation of publications (Desk-Top Publishing) is loaded. The hardware for this system includes a scanning device, an IBM PC-AT computer with 40 megabyte Winchester disk and color monitor, as well as HPLAZER JET+ laser printer. The PPP VENTURA PUBLISHER (VP) is used as the basic software. In addition, a converter from format to VP format was developed. This system provides for automated publication of several bibliographic indexes. One of the main ones is the "Current index of scientific medical literature," put out weekly in Russian and English. It consists of three main parts: bibliographic description of documents, permutation index of key words from document titles, and author index.

At the present time telecommunication equipment for access to Russian and foreign databases via VNIIPAS in the on-line mode is installed at the Soyuzmedinform of GTsNMB. In addition, there are two work stations at the GTsNMB with CD-ROM equipment, in which the MEDLINE and DRUG INFORMATION databases have been installed.

#### 4. Organizational and Economic Aspects of System Operation

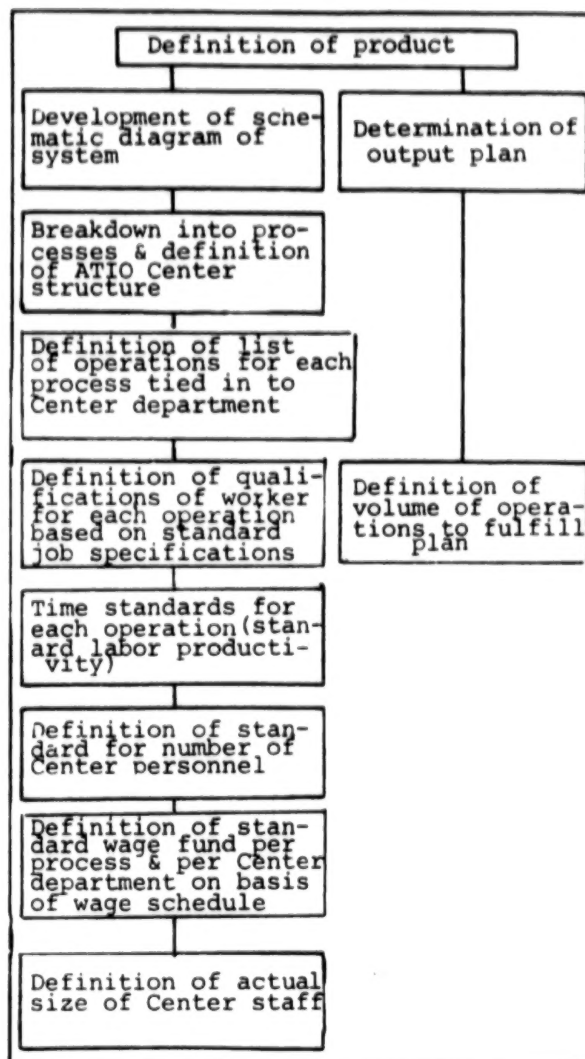
For the purpose of practical utilization of the equipment, it was decided to establish a special department within the GTsNMB, the Center for Automated Technology of Information Services (ATIO), which would operate on the basis of a collective contract. Several successive steps were taken, as illustrated in Chart 3, to switch the ATIO Center to collective contractual operation.

The planned indicators listed in Section 2 were specified for the ATIO Center for 1989-1990.

In addition to quantitative indicators, the system provides for achieving good production indicators. This refers to fullness of the base, in-depth indexing, low percentage of spelling errors, and strict adherence to target dates for fulfilling orders.

Chart 2 illustrates how the Center operates. Then, each process was broken down in detail into standard operations, such as coding, marking, formation of uniform batches of documents, indexing on monographic and analytical levels, editing, editing of subject and other catalogues, opening up new headings (descriptors), translating and editing titles, input and processing of books and articles according to subject, preparation of file for the publishing system and other operations. In all, more

Chart 3. Sequence of steps taken to switch ATIO Center to Collective Contractual Operation



than 100 operations were singled out. The list and volume of standard operations were defined for each output product.

Then, on the basis of the standard job instructions, the specialty and qualifications of the worker for each operation were defined. Further, determination is made of the time standards for each operation, on the basis of existing norms or time studies, which is equivalent to the standard productivity for each position. Determination was then made of standard number of workers at the Center. For this purpose, on the basis of the specified plan for production and distribution of operations according to output products, determination is made of the overall planned volume of operations, which is divided by the labor productivity of each position. At the next stage, using standard wage scales, determination is made of the overall standard wage fund for each department of the Center. On the basis of the actual number of

employees, determination was then made of the actual number of Center departments for which a work plan and planned wage fund are specified.

There is monthly delivery of information output, with assessment of its quantity and quality, after which calculation is made of wages for each employee on the basis of the index of participation in the work. The total wage fund of the Center for planned 1989 indicators constituted 230,000 rubles for 83 employees. The cost per entry in the bilingual database was 5 rubles.

#### Conclusion

We have described here the methodological bases and practical results of developing a computer system for information production on the basis of the fund of a large scientific library involving use of personal computers. We believe that this system could be the model

element for a general information network of the largest libraries in our country which would form a single electronic catalogue that would operate on the basis of a high-power computer complex providing reliable on-line access.

The Soyuzmedinform library-information system is inexpensive, highly reliable, and offers broad opportunities for producing information that meets the international standard. All these qualities made it possible to find a wide circle of consumers. Suffice it to state that this system is already in operation in more than 10 libraries and information centers of our country, the largest of which are the Saltykov-Shchedrin Library in Leningrad and the GPNTB [State Public Scientific and Technical Library] of the Siberian Department of the USSR Academy of Sciences.

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